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# VARIATION IN NUPE PHONOLOGY AND MORPHOLOGY

by

AHMADU NDANUSA KAWU

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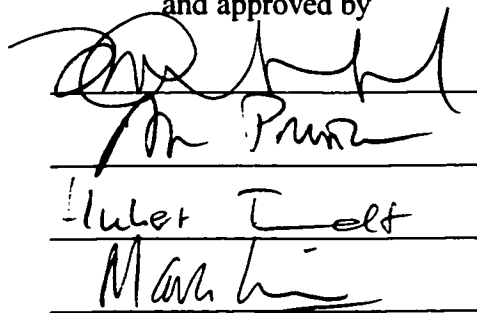
Doctor of Philosophy

Graduate Program in Linguistics

written under the direction of

Akinbiyi Mudathir Akinlabi

and approved by



The first signature is a cursive script, likely of the advisor. The second signature is written in a more stylized, blocky cursive. The third signature is also cursive and appears to be a second approver's name.

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**ABSTRACT OF THE DISSERTATION**  
**Variation in Nupe Phonology and Morphology**  
**by AHMADU NDANUSA KAWU**

**Dissertation Director:**  
**Akinbiyi Mudathir Akinlabi**

This dissertation addresses the challenge that intralinguistic variation poses for Optimality Theory. The difference between languages—interlinguistic variation—is a function of constraint reranking. The challenge of intralinguistic variation is accounting for differences within a language with respect to the same phonological phenomenon that requires constraint reranking with the potential for ranking paradoxes. I propose a unified approach to intralinguistic variation that involves deploying special constraints—constraints that are active in variation contexts—in the constraint hierarchy motivated for the analysis of nonvariable phenomena. The interaction of the special constraints with the hierarchies for nonvariable phenomena accounts for interstratal and intralinguistic typological variation, and optionality. It preempts any ranking paradoxes that might otherwise ensue. Variation manifests in Nupe in the domains of loan phonology, hiatus resolution, and affixation.

Loan phonology engenders interstratal variation whereby there is divergence between the native and loan strata. The failure of loanwords to conform to the structure of

the target language is explained by ranking a loan faithfulness constraint—a special constraint—above the hierarchy motivated for the structures of the native stratum. This prevents reranking the constraints to explain the structures in the loan stratum. Distribution of stridents in Nupe illustrates interstratal variation. Stratal convergence is assured by subordinating a loan faithfulness constraint to the hierarchy of the target language.

The prohibition of hiatus—heterosyllabic vowel sequences—necessitates a number of hiatus resolution strategies. The presence of multiple strategies in a language engenders intralinguistic typological variation. The strategies in Nupe are glide formation, assimilation, and elision. Glide formation is the primary strategy. Relevant special constraints are motivated and deployed into the hierarchy for the primary strategy to account for the other strategies.

Optionality manifests in Nupe in gerundial affixation. Gerundial affixation to some verb stems results in more than one optimal output. The analysis of optionality appeals to crucial nonranking between the constraints violated by each optimal output.

The dissertation not only adequately describes and analyzes aspects of Nupe loan phonology, hiatus resolution, and affixation, but also answers the conceptual challenge that intralinguistic variation poses for Optimality Theory. It further advocates novel approaches to familiar phonological and morphological phenomena.

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## **DEDICATION**

**To my wife Memunat, and sons Aliyu and Umar for patiently and gracefully enduring and persevering during my long absence from home in my quest for knowledge and wisdom.**



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## CHAPTER ONE

### VARIATION AND SPECIAL CONSTRAINTS

#### **1. Introduction**

In Optimality Theory (OT; Prince & Smolensky 1993) interlinguistic variation—the difference between languages—is a function of reranking a universal set of constraints. Though each different ranking may instantiate a different grammar, and thus a different language, it is not guaranteed that each such grammar is attested in natural languages. Constraint rankings capture phonological generalizations, generalizations that differ from one language to the other. It may happen that the different generalizations predicted to hold across languages hold within the same language. When this happens, intralinguistic variation ensues with attendant problems for the theory. The focus of this dissertation is thus intralinguistic variation and the challenges that it poses to OT.

The primary language of investigation is Nupe, a Nupoid language of the Benue-Congo subfamily of the Niger-Congo family of languages of Africa (Bendor-Samuel 1989, Blench 1989, and Williamson 1989). Variation manifests in different domains of the phonology and morphology of the language. These include loan phonology, hiatus resolution, and affixation. Each domain presents a different kind of variation. The type of variation notwithstanding, the challenge for the theory is essentially the same. In view of the generality of the challenge, a general approach to intralinguistic variation is proposed. Subtle differences between the variation types are built into the general approach as necessary.

The general approach to intralinguistic variation developed in the following chapters appeals to special constraints (Prince 1997, 1999). Special constraints are

defined relative to general constraints. Since the special constraints only manifest in the context of variable phonological phenomena they should be ideally characterized as latent constraints (cf. Liberman 1994). This characterization is especially appropriate, as it is not in every instance of variation that a special constraint can be defined relative to a corresponding general constraint. In this regard all constraints that manifest in the variation context are latent.

The constraint interaction that captures the generalization of a nonvariable phenomenon may be jeopardized in the context of variation that might require the opposite generalization. Deploying a special constraint into the established hierarchy preempts the potential paradox and allows for both generalizations to hold within the language. In the following sections I review the basic tenets of Optimality Theory, identify the potential challenges of intralinguistic variation, discuss the domains in which variation holds in Nupe phonology and morphology, the variation type involved, and the place of special constraints in accounting for intralinguistic variation. Finally I present an overview of the remaining chapters of the dissertation.

## **2. Optimality Theory**

Optimality Theory explores the idea that Universal Grammar (UG) consists of a set of constraints on structural well-formedness. Individual grammars are constructed out of this set of constraints. Constraints that define the grammar of particular languages are usually in conflict as they make different demands on the well-formedness of structures. Internal to the grammar is the means of resolving conflicts between constraints. An OT grammar comprises some components and general principles. The first component of an

OT grammar is GEN. This component generates output realizations for any given input. GEN also defines the space of possible inputs.

The output realizations of GEN are subject to the second component of the grammar CON. CON consists of a set of universal well-formedness constraints. The universality of the constraints derives from the fact that they are present in every language. The relation between the output candidates supplied by GEN and CON is mediated by the third component of the grammar EVAL. This component of the grammar evaluates the output candidates in parallel to determine the one that best satisfies the constraint set and thus the optimal analysis of the given input.

The grammaticality of the well-formed output is a function of the relation between the constraints of CON. Constraints interact in such a way that the satisfaction of one constraint takes absolute priority over the satisfaction of another. The optimal analysis necessarily satisfies some constraints and in so doing violates some others. The violated constraints, relative to the satisfied constraints, are of lesser strength. The relative strength of constraints is encoded in the principle of constraint ranking. The grammar thus ranks constraints in a strict dominance hierarchy. Constraints that are ranked high have priority over those ranked lower in the hierarchy. Prince and Smolensky (1993) make two important observations with respect to the ranking of constraints.

First, despite the strict dominance that must hold between constraints, it may happen that the ranking between a pair of constraints does not have any effect on the outcome. Noncrucial domination relations may thus exist within the constraint hierarchy. In this regard, ranking the constraints in either order will give the same result. The constraints may then have no dominance relation between each other.

Second, noncrucial dominance relations raise the possibility of crucial nonranking in which ranking the constraints either way has implications for the optimal analysis. In this respect ranking the constraints in one dominance relation results in one optimal analysis, while ranking them in the reverse dominance relation results in a different optimal analysis. The effect is that the grammar allows both rankings. In the absence of any evidence for crucial nonranking at that stage in the development of the theory, Prince and Smolensky conclude that all nonrankings are noncrucial. I demonstrate in chapter four that there are crucial nonrankings in the grammar. Such rankings are important for the analysis of optionality.

Since the constraints make different demands on linguistic forms, it is the case that the optimal analysis of a given input does not meet the demands of each and every constraint. The constraints of UG are thus violable. The violation is however minimal in that other candidates do better than the optimal output on a particular constraint, but these other candidates may fare worse on a higher ranked constraint.

The predictiveness and explanatory force of OT lies in building individual grammars from universal principles of structural well-formedness. The theory achieves this with UG providing the set of highly general conflicting constraints operative in all languages. The difference between languages is in how they resolve the conflicts between the constraints—the way that they rank the constraints in strict dominance hierarchies. The grammar of a language is thus a ranking of the universal constraints. Interlinguistic variation is a consequence of language-specific rankings of universal constraints in CON. All the possible rankings of CON result in a typology of possible human languages. There

may be restrictions on possible rankings of the set of universal constraints to the effect that some rankings may be universally fixed, and thus not permutable.

### 3. Variation

Variation as used in the following chapters refers to different generalizations with respect to a given phonological phenomenon within the same language.<sup>1</sup> The phonological phenomenon may in one instance require a particular ranking of a set of constraints. The same phenomenon in a different context may result in a different generalization that requires reranking the same set of constraints. Such reranking potentially results in ranking paradoxes. The effect of intralinguistic variation is that contradictory rankings may hold in the same grammar. In this respect each instance of variation is systematic and completely phonological. In effect the kinds of variation examined here are neither a function of sociological or extralinguistic factors, or of statistical preferences (cf. Antilla 1997, Reynolds 1994, and references therein). Though these factors can be brought to bear on the analysis of variation the primary factor is linguistic.

Intralinguistic variation in Nupe manifests in the domains of loan phonology, hiatus resolution, and affixation. A different kind of variation is instantiated in each domain. But all types of variation pose the same problem, capturing different and opposing generalizations with respect to the same phenomenon within the same grammar.

#### 3.1 *Loan phonology*

Loan phonology is one source of variation in Nupe. As with several languages the lexicon of Nupe is not restricted to items that are native to it. There are vocabulary items

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<sup>1</sup> In the OT literature variation is used to refer to optionality and language change (Antilla 1995, 1997, Antilla and Cho 1996, Itô and Mester 1997, Kiparsky 1993, 1994, Liberman 1994, and Reynolds 1994 among several others. I use the term in a broader sense to include not only optionality but all instances in

borrowed from other typologically different languages, especially Classical Arabic, English, and Hausa. The existence of loanwords stratifies the lexicon into a native stratum and a loan stratum. To a large extent loanwords tend to conform to the structure of the target language.<sup>2</sup> By conforming to the structure of the target language, the loanwords differ from their structure in the source language. But this is not always the case as the loanwords may retain their structure from the source language, and thus fail to conform to the structure of the target language. This results in differences between the native and loan strata with one generalization holding in one and the opposite generalization holding in the other. This engenders interstratal variation.

Interstratal variation is a consequence of the differences between languages. Since the lexicon of every language is regulated by a set of universal constraints, languages differ with respect to the order they impose on these constraints. In view of this, conflicts arise when languages borrow from each other. The conflict essentially revolves around maintaining the structure from the source language or conforming to the structure of the target language. The latter choice poses no problems for the constraint hierarchy of the target language. The former choice however has implications for the constraint hierarchy of the target language. The failure of the loanwords to conform to the structure of the target language may require a reordering of the constraints to accommodate the loanwords. This potentially creates a ranking paradox with the implication that the generalization that holds for the native stratum is lost. The challenge is to keep the

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which the same phonological phenomenon in a language leads to different and often conflicting generalizations.

<sup>2</sup> Structure as used here is all embracing. Structural conformity can be in terms of segments, phonotactics, prosody, and phonological processes.



generalizations that hold for both the native and loan strata without resorting to reranking and the attendant paradox.

### 3.2 *Hiatus resolution*

Hiatus resolution provides another instance of variation in Nupe. Heterosyllabic vowel sequences in Nupe are resolved differently depending on the vowels in hiatus, and the morphology of the words of which the vowels are a part. The typology of hiatus resolution strategies (cf. Casali 1996, 1997) is determined by ranking the constraints militating against each strategy such that the choice that a language makes follows from ranking the constraint against that strategy lowest in the hierarchy. The presence of multiple hiatus resolution strategies in Nupe, as in several other languages, engenders intralinguistic typological variation. Since intralinguistic typological variation requires as many rankings as there are hiatus resolution strategies in a language, the potential for ranking paradoxes is enormous.

Intralinguistic typological variation is not restricted to hiatus resolution in Nupe. Another instance of intralinguistic typological variation arises in the syllabic simplification of loanwords. Loanwords with syllable types that are not attested in Nupe—syllables with consonant clusters and codas—are modified to conform to the syllable structure of Nupe. The syllables may be modified by inserting the vowel of the preceding syllable via copying, or inserting an unmarked vowel. This results in a typology of insertion strategies with different rankings of the constraints militating against each strategy. The use of both strategies in the grammar of Nupe potentially results in a ranking paradox. The use of either strategy in loanwords from the same language is contextually determined. But it is also the case that the choice of strategy is

dependent on the source language. Here again differing generalizations with the potential for paradox have to be accounted for without resorting to reranking.

### 3.3 *Affixation*

Affixation in Nupe, in particular gerundial affixation, engenders a kind of variation different from those presented by loan phonology, and hiatus resolution and syllabic simplification of loanwords. The variation involved in gerundial affixation is such that there is more than one optimal form for a given input. For a theory that admits one optimal analysis for any given input as determined by a hierarchy in which strict dominance holds, optionality poses some challenge. Optionality has implications for strict domination within the constraint hierarchy and the computation of optimality. If strict domination must hold between constraints, then the constraint interaction that makes one form optimal may be different from the one that makes the alternative form optimal. This results in a potential paradox in the same way that other kinds of variation do.

Optionality is not the only kind of variation that affixation engenders. Since affixation is a morphological process, the predictions of the phonology may not be borne out in the morphology. This has generally been characterized as underapplication in the reduplication literature (McCarthy & Prince 1995 following Wilbur 1973). Underapplication in one instance results in strategy reversal. This is with respect to hiatus resolution in affixation contexts. The other instance of underapplication is the failure of strident palatalization in affixation. As with other instances of variation the phonological generalizations have to hold the same way that the contradictory morphological

generalizations have to hold. The constraints motivated to account for the phonological generalizations may not suffice for the morphological generalizations.

The challenge of the various kinds of intralinguistic variation highlighted above is that different interactions of the same set of constraints with the potential for ranking paradoxes is required to account for variable phenomena. The answer to this challenge, the facets of which form the focus of this dissertation, is that in addition to the constraint set motivated to account for nonvariable phenomena, special constraints manifest in the context of variable phenomena. Deploying the special constraints into the constraint hierarchies motivated for nonvariable phenomena preempts the ranking paradoxes that may otherwise result from reranking the same set of constraints to account for variation.

#### **4. Special Constraints**

Universal constraints fall into two broad classes—faithfulness and markedness constraints. Faithfulness constraints demand that input-output mappings be not different in any way. Markedness constraints on the other hand prohibit certain output structures. The interaction of these basic constraint types in the grammar of a language determines the optimal analysis of a given input. The standard theory of faithfulness is Correspondence Theory (McCarthy & Prince 1995, 1999). It has been extended in various ways by other researchers. Besides faithfulness and markedness constraints OT also recognizes alignment constraints (McCarthy & Prince 1993a) which require the alignment of edges between phonological and/or morphological constituents. All the constraint types feature in the analyses of variable and nonvariable phenomena in Nupe undertaken in the following chapters. At the appropriate points the relevant constraints

will be motivated and explained. The issue at hand is in the nature of special constraints and their role in accounting for intralinguistic variation.

Prince (1997, 1999) identifies two classes of constraints that can be related in terms of stringency. They are general (G) and special (S) constraints. The general constraint is more stringent than the special constraint. Stringency is defined relative to markedness hierarchies. In this regard, G rules out more things than S. A violation of S implies a violation of G. Conversely a satisfaction of G implies a satisfaction of S. The relations between general and special constraints may be Paninian or Anti-Paninian. The Paninian relation is such that special takes precedence over general. But given that Optimality Theory allows for free ranking of constraints, Anti-Paninian relations may arise such that general takes precedence over special.

Different ranking properties hold for constraints in a stringency relationship. The first such property is adjacency where G directly dominating S is equivalent to S directly dominating G. Therefore G and S do not conflict and when they are adjacent their mutual ranking is not crucial. G and S may however be ranked by transitivity where there is an intervening constraint that is ranked with respect to either such that  $G \gg T \gg S$  or  $S \gg T \gg G$ .

The second property is that of activity relative to candidate sets. Either S or G or both may be active on different candidate sets. If  $G \gg S$ , then G is active on some candidate set with the implication that S is not active on the same candidate set. In the same situation, if S is active on the candidate set then G is not active on the same candidate set. In terms of activity inhibition, that  $G \gg S$  does not inhibit S's activity, as S can still be active on some candidate set where G is not active. On the other hand, if  $S \gg$

G, both S and G can be active. Despite the fact that adjacency makes S's activity inessential, when S and G can be ranked by transitivity, both can be active and essential. The ranking  $G \gg S$  does not completely deactivate S, especially since inactive G allows S to be active. For S to be totally deactivated it has to be the case that no violation class of G is split by the violation classes of S for any candidate set.

The account of nonvariable phenomena may not involve any appeal to special constraints. The constraints thus involved may all be characterized as general. Variation requires an appeal to special constraints relative to the general constraints that account for nonvariable phenomena. Since the constraint hierarchy involving general constraints captures a generalization with respect to a phonological phenomenon, a different generalization with respect to the same phenomenon may require reranking the general constraints with the potential for ranking paradoxes. In order to preempt the ranking paradoxes a special constraint that encodes the context of variation is deployed into the hierarchy. In this respect, the special constraints required to account for variable phenomena may be ranked high, low, noncrucially unranked (ranking the constraints either way results in one optimal analysis) or crucially unranked (ranking the constraints either way results in more than one optimal analysis) relative to the general constraints, set up to account for nonvariable phenomena. This is the case in the different kinds of variation examined in the following chapters. The appropriate ranking of each special constraint prevents any re-ordering of the hierarchy that may lead to ranking paradoxes.

Intralinguistic variation is a factor of different generalizations with respect to the same phenomenon. Each generalization requires a different ordering of a set of constraints with the potential for paradoxes. The special constraint approach to variation

proposed in this dissertation works very simply. A set of data, say A, may be accounted for by ranking, for instance, two constraints  $C_1$  and  $C_2$  as in (1).

(1) *Ranking for data A*

$$\begin{array}{c} C_1 \\ | \\ C_2 \end{array}$$

The ranking in (1) captures a generalization with respect to data A. But consider another set of data, say B, with respect to the same phonological phenomenon. The generalization indicated by data B is different from that of data A. More specifically it contrasts with the generalization of data A. Consequently data B can be accounted for with the alternative ranking as in (2).

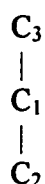
(2) *Ranking for data B*

$$\begin{array}{c} C_2 \\ | \\ C_1 \end{array}$$

The rankings (1) and (2) are contradictory and they cannot coexist in the same grammar. Allowing their coexistence results in a ranking paradox. This in general is the problem that intralinguistic variation engenders. In order to maintain the generalizations with respect to both sets of data, the difference between the two is taken into consideration. Despite the fact that the two sets of data relate to the same phonological phenomenon, the context of data A may be different from that of data B. The contextual difference necessitates a special constraint that encodes this difference, say  $C_3$ . It might be special with respect to  $C_1$  or  $C_2$ . Since data set A does not involve variation the ranking that accounts for it,  $C_1 \gg C_2$ , is kept. Rather than rerank the two constraints as in (2) to account for data set B that introduces variation,  $C_3$  is ranked with respect to (1). In

principle  $C_3$  can be ranked above, below, or unranked with respect to  $C_1$  and  $C_2$ . But for illustrative purposes, it is ranked above  $C_1$  and  $C_2$  as in (3). The ranking in (3) captures the generalizations of both data sets A and B without recourse to reranking and the attendant paradox. In effect both the special and general constraints are active in the grammar, albeit on different candidate sets.

(3) *Ranking for data A & B*



The account of interstratal variation, intralinguistic typological variation, and optionality undertaken in the following chapters essentially follows the pattern outlined above. Different sets of data with respect to the same phonological phenomenon introduce different, often contradictory, generalizations. A constraint hierarchy is motivated to account for one set of data, but accounting for the other set of contextually different data might require reordering the already established hierarchy. This reordering with the potential for ranking paradox is avoided by encoding the contextual difference in a special constraint. Ranking the special constraint within the established hierarchy preempts the ranking paradox that intralinguistic variation engenders, and allows for an adequate account of the instances of variation examined in the following chapters.

#### 4.1 *Illustration*

In Indonesian (Cohn 1989, Cohn & McCarthy 1994, McCarthy & Prince 1993a) hiatus is resolved by what is commonly characterized as glide epenthesis as in (4).

(4) *Hiatus resolution in Indonesian*

diam	→	di.jam.	‘quiet’
buah	→	bu.wah.	‘fruit’
udzi-an	→	u.dʒi.jan.	‘test’
bantu-an	→	ban.tu.wan.	‘aid, relief’
hari-an	→	ha.ri.jan.	‘daily’

The data in (4) indicate that heterosyllabic vowel sequences are structurally marked. The markedness of such structures is improved via glide epenthesis.<sup>3</sup> Kawu (2000c) argues that there are three options for improving marked syllable structures—deletion, epenthesizing an unmarked segment, or copying a segment that is already in the input. Putting aside deletion, the choice of epenthesis or copying is attributed to the interaction between the correspondence constraints in (5) that I refer to as insertion-prohibiting constraints.

(5) *Insertion-prohibiting constraints* (cf. McCarthy & Prince 1995)

## a. DEP

Every segment of the output has a correspondent in the input.

## b. INTEGRITY

No segment in the input has multiple correspondents in the output.

The ranking between (5a) and (5b) determines the choice of insertion strategy. This interaction results in the schemata in (6), one of which favors epenthesis while the other favors copying.

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<sup>3</sup> Chapter three is a detailed discussion of hiatus resolution. There, I describe hiatus, the motivation for hiatus resolution, and the constraint against hiatus, among other issues. For the purpose of illustrating the problem of intralinguistic variation and the proposed approach I appeal only to the basic constraint



(6) *Schemata of insertion strategies*a. *Epenthesis*b. *Copying*

On the view that the glides in the data in (4) are copies of the preceding vowels resulting in the input vowels having multiple correspondents in the output, the ranking (6b)—DEP » INTEGRITY can be said to hold in the grammar of Indonesian.

A second set of data with respect to hiatus resolution exhibits a different strategy.

The glottal stop is inserted in place of the glides as in (7).

(7) *Hiatus resolution in Indonesian*

di-angkat	di.ʔan.kat.	(*di.jan.kat.)	‘be lifted’
di-ukir	di.ʔu.kir.	(*di.ju.kir.)	‘be carved’
di-ambil	di.ʔam.bil.	(*di.jam.bil.)	‘be taken’
api-api	a.pi.ʔa.pi.	(*a.pi.ja.pi.)	‘fires’

The glottal stop in the data in (7) is epenthetic, it lacks a correspondent in the input. This requires the ranking (6a)—INTEGRITY » DEP—and hence epenthesis as an insertion strategy. Allowing the two rankings in (6) to hold in the grammar of Indonesian would create a ranking paradox. In order to preempt the paradox, a special constraint is

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interaction that illustrates the proposal. A more detailed analysis of the Indonesian data is given in chapter three.

motivated and ranked accordingly. A comparison of the data sets (4) and (7) reveals a difference in the affiliation of the vowels that should copy. In (4) the copied vowels are root vowels while in (7) the vowels in the corresponding position are in the affix. This difference suggests that root vowels can have multiple output correspondents while affixal vowels cannot. INTEGRITY can then be relativized to roots and vowels with the ranking INTEGRITY-AFFIX » INTEGRITY-ROOT.<sup>4</sup>

On the view that INTEGRITY-AFFIX as defined in (8) is a special constraint, it can be ranked with respect to the copying schema so as to prevent affixal segments from having multiple output correspondents. Given that there is an intervening constraint the special and general constraints are active on different candidate sets.

(8) INTEGRITY-AFFIX

No segment in the affix has multiple correspondents in the output.

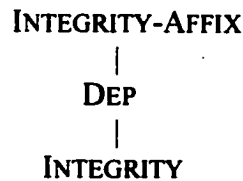
The constraint (8) encodes the context of variation, and its ranking with respect to the copying schema as in (9) accounts for the copying in (4) as well as for the epenthesis in (7) without recourse to reranking the insertion-prohibiting constraints. It further preempts the ranking paradox that might otherwise result from keeping both the copying and epenthesis rankings in the grammar of Indonesian.<sup>5</sup>

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<sup>4</sup> This ranking has implications for McCarthy & Prince's (1995) Root-Affix Faithfulness Metaconstraint (FAITH-ROOT » FAITH-AFFIX) given that INTEGRITY is a faithfulness constraint. I address this in more detail in chapter three.

<sup>5</sup> Since the affixal vowel does not copy in the data in (7) the question arises as to why the root vowel does not copy instead especially in a form such as *di-ukir* 'be carved' where the root vowel has a corresponding glide. This is a factor of directionality, and I address the issue in more detail in chapter three.

(9) *Ranking for copying and epenthesis in hiatus resolution in Indonesian*



## 5. Overview of Dissertation

The following is an overview of the remaining chapters of the dissertation.

### Chapter 2: Loan Phonology

This chapter discusses the divergence and convergence between the native and loan strata in Nupe. Divergence between the two strata is the source of interstratal variation. Specifically the distribution of stridents in Nupe to the effect that alveolar stridents are found before back vowels while their palatal counterparts are found before front vowels is not conformed with in loanwords from Classical Arabic and Hausa. In such loanwords both strident types are found before both vowel types respectively. The constraint interaction that accounts for the distribution of stridents in the native stratum thus needs tinkering with to accommodate the distribution in the native stratum. This tinkering, if successful, engenders a ranking paradox. The fact that the loanwords exhibit a different distribution is used to argue for the recognition of constraints that regulate loan inputs and their outputs in the target language. The relevant loan faithfulness constraint is deployed accordingly into the hierarchy that accounts for strident distribution in the native stratum, and the potential ranking paradox is avoided. Convergence between the native and loan strata is demonstrated with the syllabic simplification of loanwords to conform to the attested syllable structures of Nupe. Convergence, in contrast to divergence, is a factor of subordinating a loan faithfulness constraint to the hierarchy of

the native stratum. Though the approach can predict both convergence and divergence, only divergence engenders interstratal variation. Interstratal variation is further illustrated with the difference in the choice of markedness improvement strategy for word-initial high tone onsetless syllables resulting from gerundial affixation and similar structures emerging from loanword adaptation in Yoruba. I further argue for a constraint-based model of lexical organization using loan faithfulness constraints that derives the lexicon of a language from a single constraint hierarchy regardless of the differences between the native and loan strata. The implications of the proposed model for learnability are identified, and the advantages over other constraint-based approaches to lexical stratification (Fukuzawa 1998, Fukuzawa, Kitahara & Ota 1998, Itô & Mester 1995ab, 1999, 2000) are highlighted. The chapter concludes by examining sundry issues in loan phonology.

### **Chapter 3: Hiatus Resolution**

The markedness of heterosyllabic vowel sequences necessitates a number of hiatus resolution strategies. The choice of strategy is a function of the ranking of the constraint that militates against that strategy. The presence of multiple hiatus resolution strategies in a language engenders intralinguistic typological variation since each ranking instantiates a typology of hiatus resolution strategies. This is the situation in Nupe where glide formation, assimilation, and elision are used as hiatus resolution strategies. I argue in this chapter that the primary hiatus resolution strategy in the language is glide formation. This is complemented by assimilation when the gliding vowel lacks a corresponding glide, while elision is a special strategy that affects the nominal prefix in nouns of the form *e*-CV. The ranking paradox engendered by multiple hiatus resolution strategies is resolved

by motivating special constraints that capture each context in which variation occurs and deploying them accordingly into the hierarchy. The approach to hiatus resolution argued for integrates universal tendencies with language-particular idiosyncrasies. This is used to argue for a typology of hiatus resolution strategies that partitions grammars into those that allow and prohibit hiatus. Hiatus-prohibiting grammars have available to them a number of resolution strategies depending on whether they permit tautosyllabification or not. The typology is based on the constraints against hiatus and complex nuclei arising from tautosyllabification, and correspondence faithfulness constraints that monitor input-output mappings. Language-particular idiosyncrasies can be factored into this typology to account for multiple hiatus resolution strategies in languages without recourse to reranking and the paradoxes that might result. Pertinent issues with respect to the hiatus phenomenon vis-à-vis other approaches (Casali 1996, 1997, Ola-Orie & Pulleyblank 2000, Pulleyblank 1998, and Rosenthal 1994, 1997) are discussed. Another instance of intralinguistic typological variation discussed is the use of different strategies (copying and epenthesis) for the syllabic simplification of loanwords requiring a different ranking of the same set of constraints. The choice of strategy depends on the context and source language. The potential ranking paradox is avoided by motivating appropriate constraints and deploying them into the hierarchy.

#### **Chapter 4: Affixation**

This chapter examines Nupe morphology. It discusses the characteristics of the major lexical categories—nouns, adjectives, verbs, and adverbs—of the language. The peculiarities of each lexical category are identified. The characteristics of these lexical categories are examined in the context of the claims of Optimality Theory about such

categories. The discussion of affixation centers on different affix types in Nupe. Affixes fall primarily into two classes—segmentally contentful and segmentally empty affixes. I discuss a number of segmentally contentful affixes and how their characteristics shape their realization when they attach to stems. Segmentally empty affixes may be realized as epenthetic segments or as copies of their host stem. Their realization as copies of the host stem is determined by their inherent characteristics. The realization of segmentally empty affixes is mediated by the Integrity Model of Copying. Examples of partially specified affixes in Tiberian Hebrew and Yoruba using the same model are discussed. Gerundial affixation presents an instance of optionality in which gerunds formed from some verb stems have more than one grammatical form. Optionality is argued to be a factor of crucial nonranking between constraints that favor one form over the other. Another source of optionality derives from input complexity. Here both forms violate the same constraint to the same degree and no other constraint discriminates between them. Underapplication is discussed as an instance of variation in which the predictions of the phonology with respect to strident distribution and hiatus resolution are not borne out in the morphology. Both instances of variation are accounted for by motivating special constraints and deploying them accordingly into the established hierarchy.

## **Chapter 5: Conclusion**

This chapter summarizes the results of the preceding chapters with respect to the phenomena considered. I point out areas for future research with respect to each of the phenomena discussed.

## CHAPTER TWO

### LOAN PHONOLOGY

#### 1. Introduction

The Nupe lexicon, like that of several languages of the world, is by no means homogeneous since it comprises vocabulary items that are native to it, and others that are borrowed from other languages. This stratifies the lexicon into at least a native stratum and a loan stratum. The two strata may exhibit some convergence in the sense that the restrictions that hold in the native stratum may also hold in the loan stratum. On the other hand the two may diverge such that the restrictions that hold in the native stratum may not extend to the loan stratum. This divergence leads to interstratal variation.<sup>1</sup>

In this chapter I argue for a formal mechanism for distinguishing the native stratum from the loan stratum. This consists in identifying the faithfulness and markedness constraints that govern the native stratum, the ranking of which marks the grammar of Nupe language as distinct from that of any other language. The interaction of these faithfulness and markedness constraints determines the well-formedness of output structures. The loan stratum is also governed by faithfulness constraints. These faithfulness constraints interact with the faithfulness and markedness constraints of the native stratum to determine the divergence or convergence of the two strata. When the loan faithfulness constraints are subordinate to the constraints of the native stratum there is convergence, while when those of the native stratum are subordinate to those of the loan stratum there is divergence, and consequently variation.

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<sup>1</sup> Aspects of the discussion of loan phonology in this chapter feature in earlier work (Kawu 2000c, to appear). The analyses undertaken here supercede the analyses in the cited work.

The divergence pattern is illustrated with the distribution of stridents in the native stratum, a distribution that is not respected in the loan stratum. The convergence pattern is illustrated with syllabic simplification of loanwords. I further demonstrate the utility of loan faithfulness constraints in explaining different strategies for improving structural markedness in the native stratum, and similar structures arising from loan adaptation in Yoruba.

Finally I argue for a constraint-based model of lexical organization in which the entire lexicon derives from a single constraint hierarchy despite the difference between the native and loan strata. Implications of the proposed model for learnability are explored.

## **2. Faithfulness and Markedness Constraints**

Optimality Theory (Prince and Smolensky 1993) recognizes two basic types of constraints—faithfulness and markedness constraints. They are universal by being present in all languages. The constraints interact differently to determine the optimal analysis of any given input. This interaction is in terms of dominance expressed as a ranking between conflicting constraints. In general terms, two basic patterns of interaction can be discerned, faithfulness dominating markedness, and markedness dominating faithfulness. These interaction patterns are indicated in (10).

### **(10) *Interaction of faithfulness and markedness constraints***

- a.    Faithfulness  
      |  
      Markedness
- b.    Markedness  
      |  
      Faithfulness



The interaction patterns in (10) result in the emergence of different output structures. For the first pattern more marked structures emerge, while for the second pattern less marked structures emerge. Since there are several different faithfulness and markedness constraints, they enter into different relationships of these basic patterns in the grammar of languages to determine, among other things, their segmental inventories, phonotactics, and prosody. Once the different relations are established, they constitute a constraint hierarchy. It is this hierarchy that governs the lexicon of a given language. The hierarchy assumes a homogeneous lexicon with no variability. This is not entirely the case as some amount of variation is present in the lexicon. This variation may require a different kind of relation between the constraints that constitute the hierarchy. The divergence between native vocabulary items and loan items engenders this precise situation. In order to maintain the relations that hold within the hierarchy, it is important to distinguish between the various items that constitute the lexicon. This is the subject of the next section.

### *2.1 Constraining the loan stratum*

Yip (1993) observes that adjustments to loanwords are occasioned by the fact that they come with one set of well-defined conditions from one language to one with a different set of well-defined conditions. In optimality-theoretic terms the well-defined conditions are constraint rankings. In making the adjustments, the speaker of the target language tries to keep the loan as close as possible to its original form. A formal account of loan phonology should thus endeavor to capture the resolution of the conflict between remaining faithful to the constraints of the source language and complying with those of the target language.

In order for the loans to be kept as close as possible to their original forms they ought to be governed by faithfulness constraints. Given the various dimensions on which loans can differ from their form in the source language, the faithfulness constraints can be descriptively characterized as in (11).

(11) FAITH-SOURCE

Loanwords are faithful to their form in the source language.

The descriptive characterization in (11) assumes that the loan stratum is regarded as homogeneous. The homogeneity is a factor of its being different from the native stratum. In addition, the loan stratum may behave uniformly with respect to compliance or noncompliance with the constraints of the target language. However if it is the case that the loans from different sources behave differently with respect to the constraints of the target language the relevant loan faithfulness constraint can be relativized to the different source languages. Since languages differ in the source of loanwords, loan faithfulness constraint relativization is done on a language-specific basis.

Faithfulness to the source language can be characterized in terms of Correspondence Theory (McCarthy & Prince 1995, 1999). In effect loan inputs and their outputs in the target language are regulated by correspondence constraints. These can be with respect to segments, phonotactics, and prosody. On this view, loan faithfulness is empirically interpreted, as loan outputs are related to their forms in the source language. It is however possible to interpret loan faithfulness in a conceptual sense.

The conceptual interpretation of loan faithfulness is based on the fact that differences between languages reside in language-specific rankings of universal constraints. On this view, loan faithfulness can be interpreted as faithfulness to the

constraint hierarchy of the source language. This interpretation assumes that the speaker of the target language knows the constraint hierarchy of the source language, and thus has a significant insight into the phonology of the source language. As farfetched as this may seem, LaCharité and Paradis (2000) provide phonological evidence to the effect that borrowers have a deep phonological knowledge of the source language. This is predicated on the assumption that borrowers are bilingual. Given that borrowings take place in language contact situations, borrowers are exposed to the source language but they may not necessarily speak the language to the extent that they are proficient in the source language.

Despite the validity of the empirical and conceptual interpretations of loan faithfulness I adopt the empirical interpretation. This better serves the analysis of loan adaptation as it allows for comparing loan inputs and their outputs in the target language. Relevant loan faithfulness constraints can thus be motivated to regulate the loan inputs and their corresponding outputs. Despite adopting the empirical interpretation I explore the conceptual interpretation at some points in the analysis.

A pertinent question that arises is whether the speakers of the target language ever know the source of the loanwords. To the extent that borrowings take place in language contact situations, the speakers are aware of the language of the people that they are in contact with. Thus at the point of contact the speakers know the source of the loanwords. Later generations may have no knowledge of these sources. However since speakers have a knowledge of the phonology of their own language, it should not be difficult to discern the fact that some vocabulary items exhibit characteristics different from those that are native to his language. In this regard they are able to attribute these to a language other

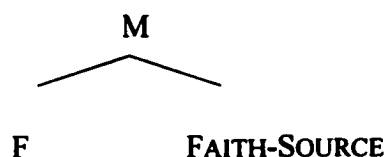
than their own. For the purpose of analysis, relevant loan faithfulness constraints will be characterized as faithfulness to the source language. The source language is only identified when the target language treats inputs from different languages differently.

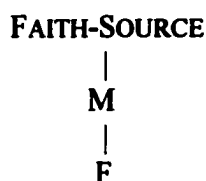
## 2.2 *Interaction between the native and loan strata*

The native and loan strata can interact in one of two fundamental ways. If for a given phenomenon there is a faithfulness-markedness ranking that holds in the native stratum to the effect that the output structure is less marked than the input, loans can react to this ranking in one of two ways. First, they may respect this ranking and thus conform to the output patterns attested in the native stratum. Second, they may fail to conform to the output patterns attested in the native stratum, and by so doing retain the structure from the source language. Consequently, both marked and less marked outputs are attested in the lexicon. Accounting for this difference may require a reranking of the constraints of the native stratum. This, if allowed, however leads to a ranking paradox and loss of generalization. Introducing a loan faithfulness constraint into the hierarchy nips the problem in the bud.

The two basic patterns of interaction between the native and loan strata are illustrated in the schemata in (12) and (13) with M standing for some markedness constraint and F for some faithfulness constraint in the target language, and FAITH-SOURCE for a related loan faithfulness constraint.

### (12) *Loan modification schema*



(13) *Loan nonmodification schema*

In the schemata (12) and (13) the ranking  $M \gg F$  governs the native stratum and ensures that only less marked structures emerge in the stratum. In (12) the crucial ranking that captures the modification of loanwords is  $M \gg \text{FAITH-SOURCE}$ . It ensures that loans conform to the structure of the target language and by so doing are unfaithful to the source language. This ranking assures convergence between the native and loan strata to the effect that only less marked structures emerge in the entire lexicon. There is no crucial ranking between  $F$  and  $\text{FAITH-SOURCE}$  as they are both dominated by  $M$ . In (13) the crucial ranking is  $\text{FAITH-SOURCE} \gg M$ . By this ranking loans fail to conform to the structure of the target language, and thus retain the structure from the source language. This ranking leads to a divergence between the native and loan strata. The effect is that while only less marked structures are attested in the native stratum, more marked structures emerge in the loan stratum. The two schemata are used to account for the distribution of stridents in Nupe where there is divergence between the two strata, and the syllabic simplification of loanwords that show convergence with respect to syllable structure. The role of loan faithfulness constraints in the choice of markedness improvement strategy in the native and loan strata is illustrated with Yoruba high tone onsetless syllable resolution in native vocabulary items and loanwords.

### 3. Distribution of Stridents in Nupe

The distribution of stridents in Nupe is such that the alveolar stridents [s, z, ts, dz] occur before the vowels [a, ǎ, o, u, ũ] and light diphthongs [wa, wǎ], while the palatal stridents [ʃ, ʒ, tʃ, dʒ] occur before the vowels [i, ĩ, e] and the light diphthongs [ja, jǎ] (Smith 1967, Hyman 1970a, Kawu 2000a). The palatals have thus been analyzed as allophones of the alveolars. Examples of the distribution of alveolar stridents are given in (14), while those of palatal stridents are given in (15).<sup>2</sup>

#### (14) *Distribution of alveolar stridents*

##### a. [s] before [a, ǎ, o, u, ũ, wa]

sa	‘slice’
esa	‘net’
sǎ	‘swell’
esǎ	‘salt’
so	‘hide’
kúsò	‘forest’
sùúsùúgi	‘waxbill’
sũ	‘bear fruit’
èsũ	‘tomorrow’
èswà	‘section’

## b. [z] before [a, ǣ, o, u, ũ]

za	‘wander’
ezà	‘person’
zǎ́	‘flood’
ezǎ̀	‘walk’
zò	‘be difficult’
ezo	‘beans’
zǔ́	‘slaughter’
ezǔ̀	‘clay’

## c. [ts] before [a, ǣ, o, u, ũ, wa, wǎ]

tσα	‘embroider’
etsa	‘facial marks’
tsǣ	‘rattle’
etsǣ	‘laughter’
tsò	‘set’
tsu	‘shut’
etsu	‘king’
tsǔ́	‘meet’
etsǔ̀	‘boa constrictor’
tswa	‘forge’

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<sup>2</sup> Data are transcribed throughout using IPA symbols except where otherwise indicated.

etswa	‘moon’
tswǎ́	‘winnow’
ètswǎ́	‘odor’

d. [dz] before [a, ǎ, o, u, ũ, wa, wǎ]

dzá	‘snap’
èdzá	‘sash’
dzǎ́	‘rinse’
èdzǎ́	‘drummer’
dzò	‘plant’
edzò	‘seed’
dzu	‘pierce’
edzú	‘slap’
dzù	‘exit’
dzwa	‘cut up’
dzwǎ́	‘flash’

(15) *Distribution of palatal stridents*

a. [ʃ] before [i, ĭ, e, ja, jǎ]

ʃi	‘buy’
eʃĭ	‘twenty’
eʃí	‘waist’
ʃe	‘drizzle’



bife · 'chicken'

èfjá 'olives'

efjá́kó 'skunk'

b. [ʒ] before [i, ɪ, e, ja]

ʒi 'confuse'

eʒi 'egg'

ʒí 'stir'

ʒe 'hit'

guʒja · 'peanuts'

c. [tʃ] before [i, ɪ, e, ja]

tʃi 'be situated'

etʃi 'yam'

tʃi 'love'

etʃí 'mucus'

tʃé 'throw'

ètʃé 'bonus'

tʃjà · 'begin'

d. [dʒ] before [i, ĩ, e, ja]

dʒijà ‘be poor’

dʒĩ ‘do’

dʒè ‘flow’

èdʒjà ‘rafter’

The table in (16) summarizes the distribution pattern of stridents in Nupe. Gaps in the table indicate that such combinations are possible but not attested. The gaps are thus accidental.

(16) *Distribution of stridents in Nupe*

	i	ĩ	e	ja	jā	a	ā	o	u	ũ	wa	wā
s	×	×	×	×	×	✓	✓	✓	✓	✓	✓	
z	×	×	×	×	×	✓	✓	✓	✓	✓		
ts	×	×	×	×	×	✓	✓	✓	✓	✓	✓	✓
dz	×	×	×	×	×	✓	✓	✓	✓	✓	✓	✓
ʃ	✓	✓	✓	✓	✓	×	×	×	×	×	×	×
ʒ	✓	✓	✓	✓		×	×	×	×	×	×	×
tʃ	✓	✓	✓	✓		×	×	×	×	×	×	×
dʒ	✓	✓	✓	✓		×	×	×	×	×	×	×

### 3.1 Analysis

The complementary distribution between the alveolar and palatal stridents in Nupe can be attributed to the assimilation of some feature of the following vowel. In the constriction-based model of feature geometry (Clements 1989, 1991, 1993, Clements and Hume 1995, Herzallah 1990, Hume 1992) consonants and vowels are described with the same features. Features shared by consonants and vowels include place features. These are [coronal], [labial], and [dorsal]. In this regard coronal consonants and front vowels are [coronal], labial consonants and round vowels are [labial], while dorsal consonants and

back vowels are [dorsal]. For consonants these features are linked under the C-place node while they are linked under the V-place node for vowels. Of these features, only [coronal] further dominates other features, [anterior] and [distributed]. While consonants can have either value for [anterior], coronal vowels are always [-anterior].

In view of the foregoing, the alveolars are [+anterior] while the corresponding palatals are [-anterior]. On the other hand the front vowels and light diphthongs [i, ī, e, ja, jã] are [-anterior]. The [-anterior] value of the light diphthongs is contributed by the [coronal] glide half. On the view that assimilation is feature spreading, strident palatalization can be regarded as the spreading of the [-anterior] feature of coronal vowels to the C-Place node of the stridents. This results in the delinking of their [+anterior] specification. Strident palatalization is thus triggered by front vowels and light diphthongs in Nupe. Smith's (1967) and Hyman's (1970a) analysis of the complementary distribution between alveolar and palatal stridents regards the alveolars as the underlying phonemes and the palatals as conditioned allophones. Essentially then only the alveolars can be present in the underlying structure while the corresponding palatals are derived by a rule of strident palatalization.

In Optimality Theory, however, richness of the base (Prince & Smolensky 1993, Smolensky 1996) allows for all possible inputs, if not otherwise restricted by GEN. The optimal output is thus determined by the interaction between the constraints that are active in particular languages. The distribution of stridents in Nupe can thus be accounted for with constraint interaction. Two things are required. First, the relevant constraints need to be motivated. Second, the distribution must be shown to follow from the interaction of these constraints regardless of whether alveolars or palatals are underlying.

The occurrence of the alveolars before noncoronal vowels, and the palatals before coronal vowels can be attributed to featural agreement between adjacent segments (cf. Baković 2000, Beckman 1998, Butska 1998, and Lombardi 1996ab, 1999 on agreement constraints). Since alveolars and palatals differ in terms of the feature [anterior], the featural agreement required between a strident and a following vowel is in anteriority. While coronal consonants can have either value for the feature [anterior], the feature is not contrastive for coronal vowels. In addition, [labial] and [dorsal] vowels do not have the feature [anterior] since the feature is dependent on [coronal]. The lack of [+anterior] vowels may be attributed to a feature cooccurrence restriction expressed as a markedness constraint—\*[-consonantal, +anterior]. The constraint is considered an inviolable part of GEN rather than a rankable and violable constraint as [+anterior] vowels are not attested in any language of the world. Alveolars before coronal vowels disagree in the feature [anterior], and palatals before front vowels agree in the feature [anterior]. On the other hand alveolars before [labial] and [dorsal] vowels vacuously agree in the feature [anterior].

In view of the dependence of the feature [anterior] on [coronal] the relevant agreement constraint is formulated in such a way as to apply to a sequence of coronal stridents and vowels. The constraint is given in (17).

(17) AGREE(anterior)

A sequence of coronal strident and vowel must agree in the feature [anterior]. AGREE(anterior) is a markedness constraint in the sense that a coronal strident and vowel sequence that have different values for the feature [anterior] is more marked than one with the same value for the feature.

A faithfulness constraint that demands identity between strident inputs and their corresponding outputs is required. This is given in (18).

(18) IDENT-IO(anterior)

Corresponding input-output segments are identical in the feature [anterior].

Besides the markedness and faithfulness constraints in (17) and (18), markedness constraints against alveolar and palatal stridents are required. They are as in (19) and (20).

(19) \* [+strident, +anterior]

Alveolar stridents are prohibited.

(20) \* [+strident, -anterior]

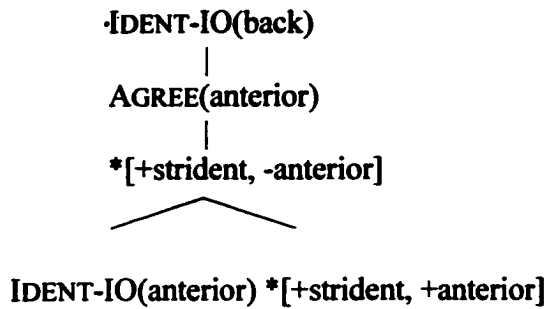
Palatal stridents are prohibited.

Since the distribution of stridents is dependent on their occurrence with a vowel, it is possible that an input in which the strident and vowel disagree in anteriority can have the vowel change in the output to satisfy agreement. Given this possibility, a faithfulness constraint for vowels is required. The feature for which the vowels must agree is one for which stridents are not distinguished. The relevant feature is [back], and the constraint is as stated in (21).

(21) IDENT-IO(back)

Corresponding input-output segments are identical in the feature [back].





The constraint interaction that is required to account for the distribution of stridents as exemplified in (14) and (15) is as in (22).

(22) *Ranking for the distribution of stridents in Nupe (Preliminary)*

The ranking arguments for the different interactions are as follows. The ranking  $\text{IDENT-IO}(\text{back}) \gg \text{AGREE}(\text{anterior})$  ensures that vowel features are not changed to satisfy agreement. The ranking  $\text{AGREE}(\text{anterior}) \gg *[\text{+strident}, \text{-anterior}]$  ensures that marked palatal stridents emerge only to satisfy agreement. The ranking  $\text{AGREE}(\text{anterior}) \gg \text{IDENT-IO}(\text{anterior})$  instantiates the  $M \gg F$  schema (10b) that assures that only less marked structures emerge. Inputs disagreeing in anteriority thus emerge in the output agreeing in anteriority, while inputs agreeing in anteriority emerge as such in the output. In order to satisfy agreement, inputs and their corresponding outputs may not be identical for the feature [anterior], hence the low ranking  $\text{IDENT-IO}(\text{anterior})$ . The ranking between the markedness constraints against stridents  $*[\text{+strident}, \text{-anterior}] \gg *[\text{+strident}, \text{+anterior}]$  ensures that palatal stridents in the input may not emerge in the output except to satisfy agreement. In such a situation it turns into the less marked alveolar strident.

The effects of the ranking (22) are as follows. Input alveolar stridents before noncoronal vowels emerge as such in the output. Alveolar stridents before coronal vowels in the input become palatals in the output. Palatal stridents before coronal vowels in the input emerge as such in the output. Input palatal stridents before noncoronal vowels become alveolars in the output. These possibilities are illustrated in the tableau in (23) with alveolar and palatal inputs. The ranking arguments are borne out in the tableau.

(23) *Tableau for distribution of stridents in Nupe*

Input: se	IDENT-IO(back)	AGREE(ant)	*[+strident, -ant]	IDENT-IO(ant)	*[+strident, +ant]
a. se		*!			*
b. so	*!				*
c.  fe			*	*	
Input: fe					
a. se		*!		*	*
b. fo	*!		*		
c.  fe			*		
Input: so					
a. fo			*!	*	
b.  so					*
Input: fo					
a. fo			*!		
b. fe	*!				
c.  so				*	*

The ranking (22) and the tableau (23) predict the input-output mappings in the table in (24). Gaps indicate unattested combinations.

(24) *Input-output mappings of strident-vowel combinations in Nupe*

	i	ĩ	e	a	ã	o	u	ũ	ja	jã	wa	wã
s	ʃi	ʃĩ	ʃe	sa	sã	so	su	sũ	ʃja	ʃjã	swa	
z	ʒi	ʒĩ	ʒe	za	zã	zo	zu	zũ	ʒja	ʒjã		
ts	tʃi	tʃĩ	tʃe	tsa	tsã	tso	tsu	tsũ	tʃja	tʃjã	tswa	tswã
dz	dʒi	dʒĩ	dʒe	dza	dzã	dzo	dzu	dzũ	dʒja	dʒjã	dzwa	dzwã
ʃ	ʃi	ʃĩ	ʃe	sa	sã	so	su	sũ	ʃja	ʃjã	swa	swã
ʒ	ʒi	ʒĩ	ʒe	za	zã	zo	zu	zũ	ʒja		zwa	zwã
tʃ	tʃi	tʃĩ	tʃe	tsa	tsã	tso	tsu	tsũ	tʃja		tswa	tswã
dʒ	dʒi	dʒĩ	dʒe	dza	dzã	dzo	dzu	dzũ	dʒja		dzwa	dzwã

The overall effect of the foregoing analysis is that input alveolars occurring before coronal, and hence [-anterior], vowels and light diphthongs should be realized as palatals in the output, while input palatals before labial and dorsal vowels should be realized as

alveolars in the output. This effect is not borne out in the loan stratum as I show in the next section.

### 3.2 *Distribution of stridents in loanwords*

The prediction of the preceding analysis of the distribution of stridents is that alveolar stridents should be found only before labial and dorsal vowels while palatal stridents should be found only before coronal vowels which in addition are [-anterior]. In loanwords from Classical Arabic, a Semitic language, and Hausa, a Chadic language, alveolar stridents are found before coronal vowels, and palatal stridents are found before labial and dorsal vowels.<sup>3</sup> In the examples from Classical Arabic (25), alveolars fail to palatalize before coronal vowels (25a) while palatals fail to depalatalize before labial and dorsal vowels. The same is true of the examples from Hausa in (26). The starred forms are the expected outputs following the distribution pattern of the native stratum.

#### (25) *Distribution of stridents in loanwords from Classical Arabic*

	<u>Classical Arabic</u>		<u>Nupe</u>		<u>Gloss</u>
a.	musiiba	→	màsiba	*màfíba	‘calamity’
	zinaaʔ	→	zina	*ʒina	‘adultery’
	zijaara	→	zijára	*ʒijára	‘visit’
b.	dzamaaʔa	→	dʒàmâ	*dzàmâ	‘congregation/crowd’
	daradʒa	→	dárádʒa	*dárádza	‘prestige’
	dʒumaʔa	→	dʒúmâ	*dzúmâ	‘Friday’



(26) *Distribution of stridents in loanwords from Hausa*

	<u>Hausa</u>		<u>Nupe</u>		<u>Gloss</u>
a.	sífà:	→	sífa	*fífa	‘form’
	wàsí:k’à:	→	wòsíka	*wòfíka	‘letter’
b.	ǰá:wàrà:	→	ǰáwúra	*sáwúra	‘advice’

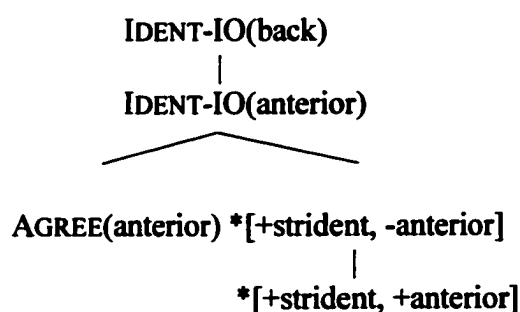
In the above examples I take as input the forms that emerge from the constraint interaction of the source language (cf. Paradis & LaCharité 1997). It is these forms that are subject to the constraints of the target language and lead to the observed modifications. Notice that there are other modifications to the loan inputs in the Nupe outputs. For the present purposes only the distribution of stridents is pertinent and it is this that I focus on. Suffice it to mention that the modifications are a factor of the constraint hierarchy governing the lexicon of Nupe.

In (25-26) were the loanwords to conform to the distribution pattern of the native stratum, the starred forms should be the optimal outputs. Their failure to conform to the pattern leads to a difference between the native and loan strata. This divergence engenders interstratal variation. In order to account for the distribution pattern in the loan stratum the constraints used to derive the distribution pattern in the native stratum would need to be ranked differently as in (27).

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<sup>3</sup> Loanwords in Nupe are discussed in Hyman 1970ab, 1973, 1985, and Smith 1967. Hyman 1970b gives an insight into the various modifications that loanwords undergo in Nupe.

(27) *Ranking for the distribution of stridents in the loan stratum*



The ranking (27) to a large extent retains the ranking relations of the ranking (22). The ranking between the markedness constraints against stridents is fixed as alveolars are less marked than palatals. Ranking the faithfulness constraint IDENT-IO(anterior) above the markedness constraints assures that input alveolars and palatals emerge without any featural changes in the output. A significant difference between rankings (22) and (27) is that in (22) the relation AGREE(anterior) » IDENT-IO(anterior) holds, while in (27) the contradictory relation IDENT-IO(anterior) » AGREE(anterior) holds. Both rankings (22) and (27) cannot therefore coexist in the grammar of Nupe without introducing a ranking paradox. In order to account for the distribution patterns in both the native and loan strata without recourse to reranking, a loan faithfulness constraint needs to be introduced into the constraint hierarchy.

The distribution pattern of stridents in the loan stratum is a factor of their retaining the value for anteriority regardless of the vowel with which they combine. The general faithfulness constraint, IDENT-IO(anterior), can have a special version that is active on loanwords. Since the general constraint is ranked below the agreement constraint, it is violated in the native stratum to satisfy the agreement constraint. The introduction of the corresponding special constraint that demands faithfulness to similar inputs from loanwords has to be ranked above the agreement constraint. The special

constraint is thus active on loan inputs, while the general constraint is not. Nonetheless a satisfaction of the special constraint implies a satisfaction of the general constraint. The special constraint is as in (28).

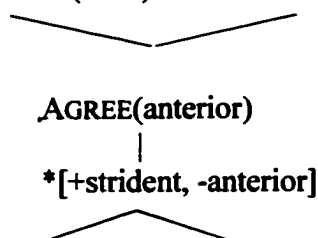
(28) IDENT-SOURCE(anterior)

Loan outputs are identical to the loan inputs in the feature [anterior].

The special constraint (28) is integrated into the hierarchy in (22) established to account for the distribution of stridents in the native stratum. This results in a single constraint hierarchy that resolves the potential ranking paradox, and accounts for the distribution of stridents in the entire Nupe lexicon. The resulting ranking is as in (29).

(29) *Ranking for the distribution of stridents in Nupe (Final)*

IDENT-IO(back) IDENT-SOURCE(anterior)



IDENT-IO(anterior) \* [+strident, +anterior]

The ranking (29) is illustrated in the tableau in (30) to derive the distribution of stridents in loanwords. The subhierarchy IDENT-SOURCE(anterior) » AGREE(anterior) » IDENT-IO(anterior) illustrates the loan nonmodification schema in (13).

(30) *Tableau for distribution of stridents in loanwords*

Input: sifā:	IDENT-IO(back)	IDENT-S(ant)	AGREE(ant)	*[+str, -ant]	IDENT-IO(ant)	*[+str, +ant]
a. <i>ʃifa</i>		*!		*	*	
b. <i>sáfa</i>	*!					*
c. <i>sifa</i>			*			*
Input: daradza						
a. <i>dárádza</i>		*!			*	*
b. <i>dárádze</i>	*!			*		
c. <i>dárádza</i>				*		

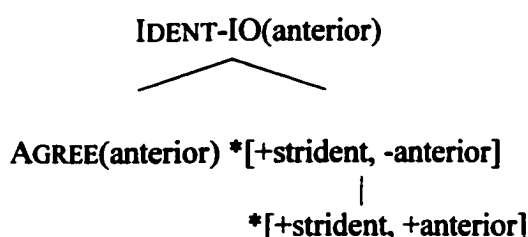
In (30), the loan input with an alveolar strident occurring before a coronal vowel, the optimal output (c) is one in which the strident is not palatalized. It thus violates the agreement constraint that similar native inputs must satisfy. But given the ranking IDENT-S(ant) » AGREE(ant), the violation of the agreement constraint is not fatal. Candidate (a) with the strident palatalized satisfies the agreement constraint and conforms to the pattern in the native stratum. It is however suboptimal as it incurs a fatal violation of the special loan faithfulness constraint. Changing the vowel to satisfy agreement as in candidate (b) results in a fatal violation of IDENT-IO(back). As in the native stratum this option is suboptimal.

In the loan input with a palatal strident before a noncoronal vowel, candidate (a) with the strident depalatalized to conform to the pattern in the native stratum incurs a fatal violation of the loan faithfulness constraint. It vacuously satisfies the agreement constraint. Candidate (b) also conforms to the pattern of the native stratum by retaining the palatal but changing the vowel to agree with it in anteriority. Retaining the palatal does not incur a violation of the loan faithfulness constraint, but incurs a fatal violation of IDENT-IO(back). The optimal candidate (c) is faithful to the input palatal strident. It vacuously satisfies the agreement constraint. It however incurs a violation of the

markedness constraint against palatal stridents. For a similar output in the native stratum, the violation is fatal. The strident thus surfaces as the less marked alveolar. But given the ranking IDENT-S(ant) » \* [+strident, -ant], the violation of the markedness constraint is not fatal.

Exploring the conceptual interpretation of faithfulness to the source as faithfulness to a subhierarchy of the source language, I show that Nupe is different from Classical Arabic and Hausa in the ranking between the faithfulness and markedness constraints that govern strident distribution given that the constraints are universal. The ranking is as in (31).

(31) *Ranking for the distribution of stridents in Classical Arabic and Hausa*



In (31) the ranking of note is IDENT-IO(anterior) » AGREE(anterior). This ranking instantiates the F » M schema (10b) which allows both marked and less marked structures to emerge. Since the markedness constraints against stridents are ranked below IDENT-IO(anterior), inputs stridents will always be identical to their corresponding outputs. The effect is that the more marked palatals will occur without any restriction just like the less marked alveolars. Thus coronal strident-vowel sequences agreeing in anteriority, as well as those disagreeing in anteriority, that is, palatals before noncoronal vowels and alveolars before coronal vowels will constitute optimal outputs. The examples in (25) and (26) are instances of the more marked outputs with strident-vowel sequences disagreeing

in anteriority. The following are instances of strident-vowel sequences agreeing in anteriority in Classical Arabic (32) and Hausa (33).

(32) *Strident-vowel sequences agreeing in anteriority in Classical Arabic*

a. [s] before [a, u]

salaam	‘peace’
samma?	‘sky’
suura	‘chapter of the Koran’
rasuul	‘messenger’

b. [z] before [a, u]

zalzala	‘earthquake’
zakaah	‘charity’
zubuur	‘Scriptures/Psalms’
zuhra	‘brightness’

c. [ʃ] before [i]

ʃirk	‘idolatry’
baʃiir	‘bringer of glad tidings’

d. [dʒ] before [i]

dʒinn	‘jinn’
dʒihaad	‘struggle’

(33) *Strident-vowel sequences agreeing in anteriority in Hausa*

## a. [s] before [a, o, u]

sàjé:	‘buy’
sàndá:	‘staff’
só:	‘love’
só:mà:	‘begin’
sù:ná:	‘name’
kàsúwá:	‘market’

## b. [z] before [a, o, u]

zámá	‘become’
kà:zá:	‘hen’
zó:	‘come’
zó:bè:	‘ring’
zúwà:	‘arrival’
bù:zú:zù:	‘dung beetle’

## c. [tʃa] before [a, o, u]

tsà:dá	‘dearness’
tsàjé	‘halt’
tsó:kà	‘muscle’
tsòró	‘fear’
tsúgúl	‘shortness’
tsú:fá	‘become old’

## d. [ʃ] before [i, e]

gíʃírí:	‘salt’
ʃígá	‘enter’
fáʃè:	‘smash’
káʃè:	‘kill’

## e. [tʃ] before [i, e]

bíntʃíké:	‘investigation’
tʃí:wò	‘illness’
tʃè:tó	‘deliverance’

## f. [dʒ] before [i, e]

gàdʒí	‘be exhausted’
dʒijà	‘yesterday’
gàdʒé:rè	‘short’
wàdʒé:	‘outside’

The foregoing is an account of the divergence between the loan and native strata where the restrictions that hold in the native stratum do not extend to the loan stratum. This failure requires reranking the constraints that govern the native stratum with the potential for ranking paradox. The paradox is preempted by motivating a loan faithfulness constraint that is a special version of a correspondence constraint active on native stratum inputs. Ranking the loan faithfulness constraint above the hierarchy that



governs the distribution of stridents in the native stratum ensures that loans are not modified to conform to the distribution pattern in the native stratum. Loans may however conform to the structure of the target language when a loan faithfulness constraint is subordinate to the hierarchy that governs the native stratum. This is the case in the syllabic simplification of loanwords, the subject of the next section.

#### 4. Syllabic Simplification

A background into syllabification in Nupe precedes the discussion of syllabic simplification in loanwords. An insight into syllabification in Nupe is provided by Smith's (1967) discussion of the canonical form of Nupe words. He observes that all words have a base syllable CV. This may be preceded by either /a/ or /e/ but by no other vowel. The other possibility is that it is preceded by a syllabic nasal consonant. He however notes that an exception to the CV base is found in pronouns and particles that he regards as syntactically bound forms. These are composed of V alone. It is thus appropriate to conclude from Smith's observations that there are three types of syllables in Nupe. These are syllabic nasal (N), vowel (V), and consonant and vowel (CV). The syllabic nasal may be regarded as a V syllable since it can bear tone. This is on the assumption that the syllable is the tone-bearing unit. For expository reasons I give examples of N and V syllables separately. Examples of words with the occurring syllable types and possible combinations (V-CV(CV), N-CV(CV), and CV-CV(CV)) are given in (34).

#### (34) *Syllable types in Nupe*

##### a. V forms

è                      'Progressive'

à	‘Future’
o	‘Focus Marker’
u	‘3rd person singular’

**b. V-CV(CV) words**

èdé	‘cloth’
ena	‘fire’
aní	‘already’
árata	‘fifty’

**c. CV words**

de	‘have’
ná	‘wash’
rè	‘indeed’
lo	‘go’
tsu	‘die’

**d. N-CV(CV) words**

ndá	‘father’
m̀bà	‘feast of mourning’
̀nkó	‘King’s council’
̀ndot̩jɪ	‘another’

**e. CV-CV(CV) words**

tsúwó	‘yesterday’
dzúró	‘red’

dʒikàná      ‘sand’

The foregoing suggests that there may be no syllables with more than one initial consonant and that all syllables are open. This rules out syllables of the type CCV and CVC. But Smith’s ensuing discussion seems to suggest otherwise. In view of such forms as in (35), he claims that the initial consonant of the base syllable may be followed by /j/ or /w/. According to him, this only happens before /a/, as the examples show.

(35) *CCV syllables?*

tjá              ‘be mild’

twá             ‘trim’

egwa           ‘hand’

egjà            ‘blood’

The examples in (35) have been of analytical importance to phonologists working on Nupe. Hyman (1970a) used these examples to argue for the usefulness of abstractness in phonological explanation. This solution has been reviewed recently by Kawu (2000a). It was demonstrated that abstractness is not required to capture the effects noted by Hyman. The basic premise of Kawu’s reanalysis is that the glide in these examples is not part of the onset, but of the nucleus. Consequently, the glide-vowel sequence is a light diphthong. Viewed this way the base CV syllable structure of Nupe formatives can be maintained without exception. V can then be a vowel, a light diphthong, or a syllabic nasal.

On pre-consonantal nasal consonants, Smith notes that they are syllabic if word initial, but non-syllabic elsewhere. Thus in the examples in (34d), the nasal consonants are syllabic. However when they are not word initial, they close a preceding pre-final

syllable as in the forms in (36). Smith cites the forms in (36) without tones on the pre-consonantal nasals. But for these, he notes that the final syllable in the word is always open. The forms in (36) on Smith's view suggest that there are syllables of the type CVC where the final C is a nasal consonant. Since it is not syllabic in this case, it is treated like any other consonant. This is not farfetched as languages that do not generally tolerate closed syllables may allow nasals in coda positions.

(36) *CVC syllables?*

gbàngbá                      'duck'

tʃènkafa                      'rice'

Contrary to Smith's citation, the medial nasals do bear tone in the examples in (36) and other words with medial consonants. The forms for 'duck' and 'rice' are thus *gbàngbá* and *tʃènkafa* respectively, with the medial nasals bearing low tone. Other examples with the medial nasal consonant bearing tone are given in (37). The tone of the nasal consonant is the same as that of the preceding vowel. There are no examples of words that contrast only in the tone on the nasal.

(37) *Medial syllabic nasal*

ńdónódò                      'every'

háńkàlĩ                      'sense'

dǎńgi                      'relative'

bambèjĩ                      'without'

gāntʃĩ                      'now'

dàńgi                      'cat'

Given that medial nasal consonants do bear tone as in the corrected citations of (36) and the examples in (37), such consonants cannot be claimed to function as codas for the preceding syllable. This is consistent with the analysis of the initial nasal consonants as syllabic. The implication is that there are no syllables of the CVC type in Nupe. Thus for instance the form for ‘rice’ is syllabified as *tʃē-ṇ-ka-fa* (CV-N-CV-CV) and not *tʃēṇ-ka-fa* (CVC-CV-CV).

On the assumption that the mora can be a tone bearing unit, the tone bearing medial nasals may be regarded as moraic, and thus non-syllabic as Smith claims. Besides being inconsistent with the treatment of initial pre-consonantal nasals as syllabic, evidence from nasalization suggests that the medial nasals are indeed syllabic. In Nupe, tautosyllabic sonorants—nasals, vowels, and glides—agree in nasality. Examples of nasal agreement are given in (38).

(38) *Nasal agreement between tautosyllabic sonorants*

jĩ	→	jĩ	‘spoil’
jǎ	→	jǎ	‘chase’
ejǎ	→	ejǎ	‘drum’
wǎ	→	wǎ	‘catch’
ewǎ	→	ewǎ	‘pregnancy’
wũ	→	wũ	‘own’
ewũ	→	ewũ	‘quarrel’
nĩ	→	nĩ	‘beat’

eni	→	enĩ	‘soup’
ná	→	nǎ	‘wash’
ena	→	enã	‘fire’
nú	→	nũ	‘be sharp’
enu	→	enũ	‘farming’
mí	→	mĩ	‘sprinkle’
emi	→	emĩ	‘mouth’
mú	→	mũ	‘suck’
èmùgi	→	èmũgi	‘flesh’
má	→	mǎ	‘be sweet’
roma	→	romã	‘broth’

In view of the data in (38) it should be possible for medial nasals to agree in nasality with the preceding vowel if they both belong to the same syllable. This is not the case as such vowels are not nasalized. The examples with medial nasals in (39) do not have the vowels and the nasals agreeing in nasality. The starred outputs are therefore not attested.

(39) *Lack of agreement in nasality between vowels and medial nasals*

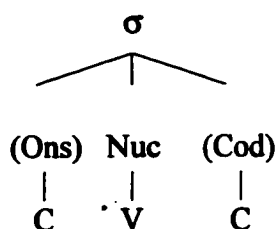
ńdónìdò	→	ńdónìdò	*ńdǒńdò	‘every’
bènte	→	bènte	*běnte	‘loin cloth’
háńkàlì	→	háńkàlì	*hǎńkàlì	‘sense’

gbà̀ngbá	→	gbà̀ngbá	*gb̃à̀ngbá	‘duck’
bambèjĩ	→	bambèjĩ	*bāmbèjĩ	‘without’
dà̀ngi	→	dà̀ngi	*d̃à̀ngi	‘cat’
gintara	→	gintara	*g̃intara	‘tongue’
bingi	→	bingi	*b̃ingi	‘type of gourd’
dungi	→	dungi	*d̃ungi	‘squirrel’
dzú́ngi	→	dzú́ngi	*dz̃ú́ngi	‘gate in a wall’

Since the preceding vowel does not agree in nasality with the medial nasal, the vowel and the nasal cannot be regarded as belonging to the same syllable. In effect, pre-consonantal medial nasals are syllabic, the same way that pre-consonantal initial nasals are. It is thus the case that there are no closed syllables in Nupe. I give an optimality-theoretic account of Nupe syllable structure in the next section.

#### 4.1 *Syllable structure constraints*

Prince and Smolensky (1993) adopt the analysis of the syllable as being a syllable node  $\sigma$  that must have a daughter *Nuc* and *may* have as leftmost and rightmost daughters the nodes *Ons(et)* and *Cod(a)*. The nodes *Ons* and *Cod* may each dominate C’s or they may be empty, while *Nuc* may only dominate V’s. Each may also dominate at most one element of C or V (Prince & Smolensky 1993:87). This gives the picture of the syllable in (40).

(40) *Structure of the syllable*

Prince & Smolensky propose a number of syllable structure constraints based on their assumptions, and for deriving syllable structure typology. These are given in (41).

(41) *Syllable structure constraints*

## a. NUC

Syllables must have nuclei.

## b. ONSET

Syllables must have onsets.

## c. NOCODA

Syllables must not have a coda.

## d. \*COMPLEX

No more than one C or V may associate to any syllable position.

The syllable structure constraints in (41) interact with a set of Faithfulness constraints to determine the optimal analysis of input structure. These Faithfulness constraints—PARSE and FILL—regulate the relation between the output structure and the input. In later work (McCarthy & Prince 1995, 1999), these have been reformulated as correspondence constraints which regulate input-output mappings as in (42).



(42) *Faithfulness constraints*

a. MAX-IO

Every segment of the input has a correspondent in the output.

(No phonological deletion.)

b. DEP-IO

Every segment of the output has a correspondent in the input.

(Prohibits phonological epenthesis.)

The thrust of Prince & Smolensky's syllable theory is that the universally optimal syllable is CV. Relative to this, syllables without onset (V), and those with codas (CVC) are less harmonic. The relative ranking of the syllable structure and Faithfulness constraints will determine the admissible syllable types in a particular language. Thus onset may be obligatory or optional, but never forbidden in a language. Coda on the other hand may be optional or forbidden in a language. In a language in which onset is obligatory and coda forbidden, only the universally optimal CV syllable type is attested. In a language where onset is optional and coda is forbidden, V and CV, but not CVC, syllable types are attested. On the other hand languages in which onset and coda are optional, V, CV, and CVC syllable types are attested.

The Nupe data in (34-37) show that onsets are optional, codas are forbidden, and there are no consonant clusters. In view of this the syllable structure and Faithfulness constraints must have the ranking in (43).

(43) *Ranking for Nupe syllable structure*

NUC, NoCODA, \*COMPLEX » MAX-IO, DEP-IO » ONSET

The ranking (43) indicates that the constraints NUC, NOCODA, \*COMPLEX are inviolable in the language. MAX-IO and DEP-IO are dominated by the syllable structure constraints. The faithfulness constraints are also not crucially ranked with respect to each other. They dominate the ONSET constraint that is violated by V syllable types. The ranking (43) is illustrated in the tableau (44) for the optimal analysis of an input V syllable. Only the constraints relevant for the illustration are included in the tableau.

(44) *Tableau for the optimal analysis of a V input syllable in Nupe*

Input: à	MAX-IO	DEP-IO	ONSET
a. <à>	*!		
b. hà		*!	
c. à			*

In (44) candidate (a) is an underparsing of the input, the input lacks an output correspondent. This fatally violates MAX-IO. It however satisfies ONSET, though gratuitously. Candidate (b) with an epenthetic segment to provide an onset for the onsetless input resulting in a universally unmarked CV output satisfies MAX-IO but fatally violates DEP-IO. Either candidate (a) or (b) would have been optimal were onsets obligatory in Nupe. The optimal candidate (c) faithfully parses the input as is resulting in a V output. This satisfies both faithfulness constraints but violates the syllable structure constraint ONSET. This violation is however of no consequence given the low ranking of the constraint. This interaction demonstrates that onsets are optional in Nupe.

That codas and consonant clusters are forbidden in the language is implied from the absence of syllable types of the form CVC, CCV, or CVCC in the language. This is not directly demonstrable from the interaction of the constraints, as there is no relevant data in the language. But if Richness of the Base is assumed, then it must be the case that inputs with codas and complex onsets and codas will be simplified either by deletion in

violation of MAX-IO or by epenthesis in violation of DEP-IO. The choice that is made will determine the ranking between MAX-IO and DEP-IO which as seen in (43) are not crucially ranked with respect to each other. Loanwords however provide the data for demonstrating that the structural constraints against such syllable types are highly ranked and may not be violated in the language.

#### 4.2 *Syllabic simplification of loanwords*

Loanwords from Classical Arabic with coda consonants do not surface with such coda consonants in Nupe. Instead a vowel is inserted and the coda consonant is parsed as an onset for the inserted vowel. This vowel is usually a copy of the vowel of the immediately preceding syllable. Examples of Classical Arabic loanwords and their realization in Nupe are given in (45). I use upper case letters for Arabic emphatic consonants. The copied vowels are in boldface.

#### (45) *Classical Arabic loanwords in Nupe*

<u>Classical Arabic</u>		<u>Nupe</u>	<u>Gloss</u>
kaafir	→	káfiri	‘unbeliever’
fitna	→	fitína	‘tumult’
kaafuur	→	kafurù	‘camphor’
luuT	→	lutù	‘homosexual’ (<Lot)
qadar	→	kádára	‘destiny’
dʒahannam	→	dʒáhánámà	‘hell’
abad	→	ábádá	‘forever’

The syllabic simplification of loanwords to conform to the unmarked CV syllable structure of Nupe is an instance of the loan modification schema (12) with the crucial

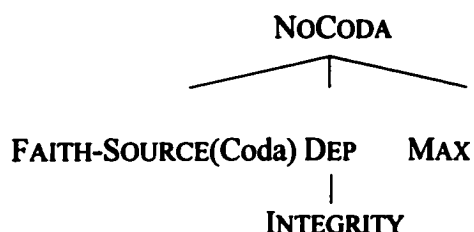
ranking  $M \gg \text{FAITH-SOURCE}$ . In order to relate the syllable structure of the loan input to the output in the target language, a loan faithfulness constraint is required to regulate the loan input and its corresponding output. The loan faithfulness constraint is stated in (46).

(46)  $\text{FAITH-SOURCE(Coda)}$

Loan outputs are faithful to the loan inputs' coda.

The modification of the syllable structure of the loan inputs is assured by the ranking  $\text{NOCODA} \gg \text{FAITH-SOURCE(Coda)}$ . The subordination of the loan faithfulness constraint to a markedness constraint of the hierarchy of the native stratum ensures that the native and loan strata converge with respect to syllable structure in the Nupe lexicon.

The choice of strategy for modifying the syllable structure of the loan input is a factor of the ranking between the insertion-prohibiting constraints discussed in chapter one in the analysis of hiatus resolution in Indonesian. The choice is between epenthesizing an unmarked vowel in violation of DEP and copying an input vowel in violation of INTEGRITY. That copying is preferred to epenthesis suggests that the ranking  $\text{DEP} \gg \text{INTEGRITY}$  holds in the grammar of Nupe. Though copying is the choice for the data under discussion, epenthesis may also be used. This may be contextually determined or source language dependent. This introduces another kind of variation that I discuss in chapter three. There I explore the full range of effects of the coexistence of copying and epenthesis in the same grammar. For the present purposes, it suffices that loanwords with codas are modified to conform to the syllable structure of Nupe. The ranking required to account for this modification is as in (47). The ranking is illustrated with a tableau in (48).

(47) *Ranking for syllabic simplification of Classical Arabic loanwords in Nupe*(48) *Tableau for syllabic simplification of Classical Arabic loanwords in Nupe*

Input: qadar	NoCODA	FAITH-SOURCE(Coda)	MAX	DEP	INTEGRITY
a. kádár	* !				
b. kádá		*	*!		
c. kádári		*		*!	
d. kádára		*			*

In (48) the input faithful candidate (a) fatally violates the structural markedness constraint NoCODA. It incurs no violation of FAITH-SOURCE(Coda) as it retains the structure with the coda from the source language. Candidate (b) avoids a violation of the markedness constraint by deleting the offending coda. But this results in a fatal violation of MAX. Candidate (c) also avoids a violation of the structural markedness constraint by epenthesizing an unmarked vowel. Since this vowel lacks a correspondent in the input the candidate incurs a fatal violation of DEP. Candidate (d), the optimal candidate, also avoids a violation of NoCODA but does so by copying the vowel of the adjacent syllable to serve as nucleus for the coda consonant. The input vowel thus has two correspondents in the output in violation of INTEGRITY. But given the ranking of this constraint with respect to DEP, the violation is not fatal. Candidates (b), (c) and (d) violate FAITH-SOURCE(Coda), since the loan input has been modified. The violations are however not fatal, given its ranking relative to the structural markedness constraint NoCODA.

The distribution of stridents in loanwords in Nupe and the syllabic simplification of loanwords illustrate the superordination of a loan faithfulness constraint to the

hierarchy of the target language, and the subordination of a loan faithfulness constraint to the hierarchy of the target language respectively. In the former case there is divergence between the native stratum and the loan stratum leading to interstratal variation, while in the latter there is convergence between the two strata. These effects are captured by motivating loan faithfulness constraints that regulate the mappings of the loan inputs to their outputs in the target language. The loan faithfulness constraints are thus useful in determining divergence or convergence between the native and loan strata depending on their ranking relative to the constraints that regulate the native stratum. Not only that, they may be used to account for a difference in the choice of markedness improvement strategies for marked structures that arise in the native stratum and similar structures from loanword adaptation. In this case marked structures barred in the native stratum are also barred in the loan stratum ensuring convergence, but such structures are improved differently. I discuss such a case in the next section.

## **5. Syllable-Tone Interaction in Yoruba**

The interaction of syllable and tones in Yoruba is such that in words of two or more syllables low and mid tones can occur on initial syllables with onset as well as those without onset. High tones on the other hand occur only on syllables with onset. Thus in nouns of the form  $v_1Cv_2$ ,  $v_1$  can only bear low or mid tone, but never a high tone, while  $v_2$  can bear any tone. Nouns with high tone on  $v_1$  are usually of the form  $Cv_1Cv_2$  (cf. Ward 1952, Oyelaran 1970, Akinlabi 1985, Pulleyblank 1986b, Bamgbose 1990, among others). This asymmetry is illustrated in the paradigm in (49) with relevant examples.

(49) *Yoruba syllable-tone association asymmetry*

## a. Low tone initial words (̀vCv)

ilú                    ‘town’

èbá                   ‘edge’

àga                   ‘chair’

èkɔ                   ‘pap’

àwò                   ‘color’

èkpà                   ‘peanuts’

## b. Mid tone initial words (vCv)

orí                   ‘head’

igbá                   ‘calabash’

afɔ                   ‘cloth’

ɔmɔ                   ‘child’

ɔdʒà                   ‘market’

ekũ                   ‘tiger’

## c. High tone initial words (\*́vCv, but ĆvCv)

díjí                   ‘mirror’                   cf. \*íjí

kélé                   ‘trouble’                   cf. \*élé

agbára                   ‘strength’                   cf. \*ára

jéje                   ‘extremity’                   cf. \*éje

kpákò                   ‘chewing stick’                   cf. \*ákó

wúra                      ‘gold’                      cf. \*úra

Optimality-theoretic approaches to syllable-tone interaction in Yoruba (Ola 1995, Akinlabi 2000, Kawu 1998, 2000c) differ on how to formally capture the asymmetry exemplified in (49). While Ola (1995) concludes that a high tone vowel cannot occur in absolute word-initial position, Akinlabi (2000) concludes that the word-initial high tone requires an onset. The constraint to the effect that a high tone vowel cannot occur in absolute word-initial position (\*#v) formulated by Ola is adopted by Akinlabi. Kawu (1998, 2000c) on the other hand attributes the asymmetry to the markedness of high tone and onsetless syllable. Given the syllable theory discussed in §4.1, the universally unmarked syllable is CV. Thus syllables without onset are marked. As for tone, the most marked tone is the high tone given the universal tone markedness hierarchy (Akinlabi 1997) in (50).

- (50) Universal Tone Markedness Hierarchy (Akinlabi 1997, cf. Pulleyblank 1986b)
- \*<sup>•</sup>[H] » \*<sup>•</sup>[L] » \*<sup>•</sup>[M]

In view of the fact that onsetless syllables abound in the language, and there are syllables with high tone, it is the case that onset is optional, and input high tone will surface faithfully despite the markedness of high tone. Though the language permits these marked structures, it prohibits the doubly marked structure in the same form. Kawu thus concludes that the appropriate constraint is a locally conjoined markedness constraint against high tone syllables without onsets as in (51).

- (51) \*H & ONSET

High tone syllables without onsets are prohibited.



The constraint in (51) captures the asymmetric pattern of syllable-tone interaction, such that the less marked tones—low and mid—can surface with onsetless syllables, while the more marked high tone cannot. Though (51) effectively captures the markedness of high tone syllables without onset, the situation in Yoruba calls for some modification of the constraint. The situation is such that there are word-internal high tone syllables without onset as in (52), and there are high tone vowel clitics as in (53) (cf. Adewole 1998, Awobuluyi 1975, Awoyale 1983, Bamgbose 1980, Manfredi 1995, Oyelaran 1992, and Pulleyblank 1986a).

(52) *Word-internal high tone onsetless syllables*

àlàáfíà (à.là.á.fí.à.)                      ‘well-being’

àáké (à.á.ké.)                                  ‘axe’

àárò (à.á.rò.)                                  ‘morning’

(53) *High tone vowel clitics*

ó    wá  
3rd Person Singular      come  
‘He came’

adé      é    wá  
Ade      Agreement      come  
‘Ade came’

owó      ʹó                                      sòro                      ó                      ní  
money Agreement      be difficult      Infinitive      have  
‘Money is hard to have’

mo                      gbà      á  
 1st Person Singular    receive 3rd Person Singular  
 ‘I received it’

The words in (52) syllabified in their citation form as indicated in parentheses suggest that the prohibition against high tone onsetless syllables in Yoruba is restricted to absolute word-initial position as claimed by Ola. The high tone vowel clitics indicated in the examples in (53) on the other hand suggest that the restriction may apply only to prosodic words. These combined effects require modifying (51) accordingly as in (54).

(54) [PRWD\*H & ONSET

High tone syllables at the left edge of prosodic words must have onsets.

The forms in (52) do not violate the modified constraint (54), as the high tone syllables without onset are not at the left edge of the prosodic word. As for the clitics in (53) they are not prosodic words and are thus excluded from the purview of the constraint. Alternatively the point can be made that the forms in (52) and (53), except for the first example (*ó wá*) in (53), create hiatus (see chapter three for a discussion of the phenomenon), and the preceding vowel and the following onsetless vowel are merged in actual pronunciation. Consequently the output in such cases do not violate (51), as they do not contain any high tone syllable without onset. Whichever version of the constraint is adopted, there are implications for Yoruba prefixation patterns to the effect that there are low and mid tone prefixes, but no high tone prefixes. The marked structure ruled out by (51) or its modified version (54) potentially arises in gerundial affixation, the subject of the next section.

### 5.1 Gerundial affixation

Yoruba forms nominals from verbs by prefixing a vowel to the verb stem. All vowels except [u] and nasalized vowels do occur as nominal prefixes. Of all the vowels that can serve to nominalize verbs *i*-prefixation results in two different nominals, substantives and gerunds. Substantives are marked by mid (55a) or low tone (55b) while gerunds are marked by high tone. Gerunds however surface with an initial consonant identical to the consonant of the verb stem (55c).

#### (55) *i*-Prefixation in Yoruba

##### a. *Mid tone substantives*

<u>Verb</u>	<u>Substantive Noun</u>	<u>Gloss</u>
d3ó	i-d3ó	‘dance; dance’
kú	i-kú	‘die; death’
só	i-só	‘fart; fart’
là	i-là	‘split; facial marks’

##### b. *Low tone substantives*

<u>Verb</u>	<u>Substantive Noun</u>	<u>Gloss</u>
mò	i-mò	‘know; knowledge’
là	i-là	‘split; line’
lù	i-lù	‘beat; drum’

##### c. *Gerunds*

<u>Verb</u>	<u>Gerund</u>		<u>Gloss</u>
d3ó	d3í-d3ó	*í-d3ó	‘dance; dancing’
kú	kí-kú	*í-kú	‘die; dying’

só	sí-só	*í-só	‘fart; farting’
mò	mí-mò	*í-mò	‘know; knowing’
là	lí-là	*í-là	‘split; splitting’
lù	lí-lù	*í-lù	‘beat; beating’

Gerunds have been variously analyzed as partial reduplication, *Ci*-prefixation (Marantz 1982, Pulleyblank 1988a), *CV* reduplicative template copying (McCarthy and Prince 1986), emergence of the unmarked (McCarthy and Prince 1994), reduplicative fixed segmentism (Alderete et al. 1997), *i*-prefixation and consonantal copying (Ola 1995, Akinlabi 2000), syllabic prefixation consisting of a copy of the first consonant followed by the oral vowel *i* (Clements and Sonaiya 1989), duplication of the initial consonant and *i*-insertion between the resulting two consonants (Abiri 1982), *C*-prefixation and *i*-epenthesis (Awobuluyi 1997), and high tone gerundial affixation with nonreduplicative copying (Kawu 1998, 2000c).

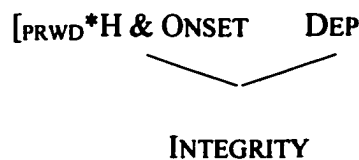
The analysis in Kawu (1998, 2000c) is essentially to the effect that the nominal prefix is *i* while the gerundive marker is the high tone. An inadvertent implication of this analysis has been pointed out to me by Akin Akinlabi (personal communication) to the effect that the gerundive marker should be able to occur on other prefixal vowels to form gerunds as distinct from the substantives that result from the prefixation of such vowels. The distinctions in (56) should thus be possible.

(56)	<u>Verb</u>		<u>Substantive</u>		<u>Gerund</u>
	tò	‘arrange’	è-tò	‘arrangement’	*té-tò
	kú	‘die’	ò-kú	‘corpse’	*kó-kú
	dɛ	‘hunt’	ɔ-dɛ	‘hunter’	*dɔ́-dɛ

jò      ‘rejoice’      a-jò      ‘joy’      \*já-jò

In view of the fact that the forms under gerund are not attested, it cannot be the case that the high tone in isolation is the gerundive marker. The restriction of the high tone to *i* suggests that the high tone and the vowel together contribute the gerundial meaning. Therefore the gerundial affix should be *i* as analyzed by Akinlabi (2000). On this view its prefixation to a verb stem potentially creates a high tone syllable without onset at the edge of a prosodic word, a potential violation of the structural markedness constraint [PRWD\*H & ONSET. The options for avoiding this violation are as in the case of syllabic simplification of loanwords in Nupe (§4.2), epenthesis of an unmarked consonant or copying an input consonant. The preference for copying as the data show is due to the ranking DEP » INTEGRITY. The ranking for Yoruba gerundial affixation is as in (57) with an illustrative tableau (58). Candidates with tonal identity changes are not considered in the tableau.

(57) *Ranking for Yoruba gerundial affixation*



(58) *Tableau for Yoruba gerundial affixation*

Input: <i>í + lù</i>	[PRWD*H & ONSET	DEP	INTEGRITY
a. <i>ílù</i>	*!		
b. <i>hílu</i>		*!	
c. <i>lílù</i>			*

In (58), the input consists of the high tone gerundial prefix (*i*), and the verb stem (*lù*). Candidate (a) has the high tone prefix attached to the verb stem. This leads to a fatal violation of the structural markedness constraint [PRWD\*H & ONSET. This violation is

avoided by candidate (b) with an epenthetic consonant to anchor the high tone onsetless syllable resulting from gerundial affixation. Since the epenthesized *h* lacks a correspondent in the input, the candidate fatally violates the anti-epenthesis constraint DEP. The optimal candidate (c) also satisfies the structural markedness constraint in the same way that candidate (b) does. However, candidate (c) does so by avoiding a violation of DEP, as the consonant of the verb stem *l* is copied to anchor the high tone onsetless syllable at the left edge of the resulting prosodic word. This results in the input consonant having two output correspondents in violation of INTEGRITY. Given the low ranking of INTEGRITY this violation has no fatal consequences.

An implication of the preceding analysis of gerundial affixation is that words in Yoruba of the form  $C_i\acute{v}C_iv$  that are not derived by gerundial affixation can be regarded as  $\acute{v}C_iv$  in the underlying structure. The consonant of the second syllable is thus copied to serve as onset for the initial high tone syllable without onset. The rarity of such forms suggests that gerundial affixation is the major source of such structures. Examples of underived words of the form  $C_i\acute{v}C_iv$  are given in (59).

(59) *Underived words of the form  $C_i\acute{v}C_iv$  in Yoruba*

jéje	‘extremity’
tété	‘game of chance’
kéké	‘facial mark’
kpákpá	‘field’
ràrà	‘elegy’
kókó	‘crux’

gǎǎ

‘type of drum’

The foregoing analysis of Yoruba gerundial affixation is justification that the language does not allow high tone syllables without onset at the left edge of prosodic words. The choice of strategy for improving the marked structure is determined by the ranking between the two faithfulness constraints—DEP and INTEGRITY. This is the only crucial ranking as that between the markedness constraint and the faithfulness constraints is not crucial. The strategy is however different for similar structures arising from English loanword adaptation.

## 5.2 Epenthesis in loanwords

Loanwords from English with initial stressed onsetless syllables are realized with a high tone and an epenthetic *h* onset in Yoruba (Ola 1995, Akinlabi 2000) as in (60). When the initial onsetless vowel is unstressed, it is realized with a low or mid tone without an epenthetic *h* as in (61).

### (60) *h*-epenthesis in English loanwords with initial stressed onsetless syllable

<u>English</u>		<u>Yoruba</u>	
énvi	→	hénfi	‘envy’
Ágli	→	hógili	‘ugly’
æləm	→	hálóòmù	‘alum’
énvələup	→	hénbílóòkù	‘envelope’
ófis	→	hófisi	‘office’

(61) *English loanwords with initial unstressed onsetless syllables*

<u>English</u>		<u>Yoruba</u>	
ædrés	→	àdírési	‘address’
ædvæns	→	àlùbànsi	‘advance’
imænjuəl	→	imánúèli	‘Emmanuel’
æraʊpléin	→	eropílèèni	‘aeroplane’

The data in (60) and (61) show that there is convergence between the native and loan strata to the effect that high tone onsetless syllables are not attested in either stratum. The loans thus conform to the structure of the target language. The divergence is in the choice of strategy to avoid outputs consisting of high tone onsetless syllables. The hierarchy already established for modifying such structures in the native stratum—DEP » INTEGRITY—favoring copying over epenthesis is jeopardized by the loan data where epenthesis is the preferred strategy. Reranking these constraints and keeping both rankings in the grammar introduces an undesirable paradox. This need not be the case if a relevant loan faithfulness constraint is introduced into the hierarchy. Since the loanwords are modified to conform to the structure of the target language, at issue is the extent to which the loanwords are modified. Epenthesis ensures a minimal distortion. Copying on the other hand might render the loans unrecognizable.

That epenthesis is a minimal distortion of the loanwords is attributable to the difference between [h] and other consonants in Yoruba. Given that the difference between [h] and other consonants that copy in the native stratum is that it is the least marked for place feature, it can be assumed that copying introduces place markedness while *h*-epenthesis does not. On this view epenthesis ensures faithfulness to the loan



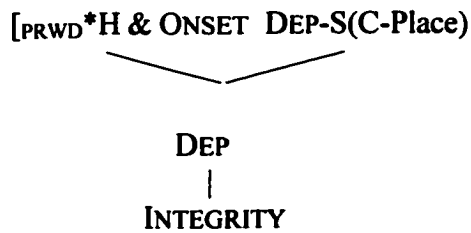
input, as no place feature is added, while copying does not, as place features are introduced. In order to capture this, the relevant loan faithfulness constraint that can be used is one that bars insertion of consonant place features in the loan output. The restriction to consonants is due to the introduction of epenthetic vowels with place features to simplify marked syllable structures of loan inputs. The constraint is defined in (62).

(62) DEP-SOURCE(C-Place)


No insertion of consonant place features in the loan output.

Introducing (61) into the hierarchy motivated for the native stratum results in the ranking in (63). The ranking is illustrated with a tableau in (64).

(63) *Ranking for epenthesis in loanwords*



(64) *Tableau for epenthesis in loanwords*

Input: æləm	[PRWD*H & ONSET	DEP-S(C-Place)	DEP	INTEGRITY
a. álǝ̀mù	*!			
b. lálǝ̀mù		*!		*
c.  hálǝ̀mù			*	

In (64), candidate (a) with the loan input realized with a high tone onsetless syllable incurs a fatal violation of [PRWD\*H & ONSET. It is otherwise faithful to the source language. Candidate (b) incurs a fatal violation of DEP-S(C-Place) as the copied consonant inserts a place feature resulting in an extreme distortion of the loan input. The optimal candidate (c) avoids a violation of DEP-S(C-Place) as the epenthetic *h* does not

introduce any place features. It however incurs a violation of DEP as the epenthetic consonant lacks an input correspondent. This violation is however not fatal. Since the epenthetic candidate violates DEP and the copying candidate violates INTEGRITY, the subhierarchy DEP » INTEGRITY that determines the choice of strategy in the native stratum is not a factor in the loan stratum. The decision thus falls to the DEP-S(Place) constraint. Consequently, loan faithfulness constraints determine the conformity or otherwise of loans to the structure of the target language. This depends on their ranking relative to the constraint hierarchy of the target language. In addition they constrain the extent to which loans are modified in conforming with the structure of the target language.

The analyses of the difference in the distribution of stridents in Nupe native and loan strata, syllabic simplification of loanwords in Nupe, the choice of markedness improvement strategy in the native and loan strata in Yoruba serve as a basis for constructing a constraint-based model of lexical organization in which the lexicon derives from a single constraint hierarchy regardless of the divergence between the native and loan strata with respect to phonological phenomena.

## **6. A Model of Lexical Stratification**

In Optimality Theory, a single constraint hierarchy governs the lexicon of a language. The challenge of lexical stratification as exemplified in the distinction between the native and loan strata, and the divergence between the two with respect to some phonological restrictions, is that the single constraint ranking is jeopardized. This is reflected in a possible reranking of the constraints motivated for the restrictions that hold in the native stratum to derive the divergence between the two strata. In the alternative, two

hierarchies can be recognized, one for the native stratum, and the other for the loan stratum. Neither of these alternatives is desirable. In the preceding discussion I have demonstrated that the fundamental issue is the convergence or divergence between the two strata. In order to maintain the ranking that governs the native stratum, loan faithfulness constraints are introduced into the hierarchy. This avoids the potential ranking paradox or different rankings of the same constraints for each stratum. Since loanwords have been shown to behave differently with respect to some phenomena in the native stratum, loan faithfulness constraints must stand in different relationships to the hierarchy of the native stratum. These different relations assure a single constraint hierarchy for the entire lexicon.

The model of lexical stratification that assures a single constraint ranking assumes a homogeneous loan stratum. This homogeneity derives from the fact that loanwords may behave uniformly relative to the phonology of the target language. This is why the loan faithfulness constraints are identified as faithfulness to the source language. Since there are different source languages for the loanwords, the faithfulness constraints can be indexed with the source language on a language-particular basis. This indexation is only required if the loanwords behave differently relative to the restrictions of the native stratum. The different languages do not each constitute a separate stratum. Nonetheless the indexed constraints can stand in different relations to the hierarchy of the native stratum, and by transitivity, to one another.<sup>4</sup>

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<sup>4</sup> Constraint-based models of lexical stratification (Fukazawa 1998, Fukuzawa, Kitahara, & Ota 1998, and Itô & Mester 1999, 2000) use constraint differentiation and indexation to different effects in accounting for lexical stratification in Japanese. The difference is that several strata are motivated for Japanese, while I assume a single nonnative stratum. I review these other approaches to lexical stratification in §7.

### 6.1 *Constraint differentiation and indexation*

In the analysis of strident distribution in Nupe, I showed that there is a divergence between the native and loan strata. The constraint hierarchy motivated to account for the distribution of stridents in the native stratum involves ranking relations between faithfulness and markedness constraints. The ranking of the faithfulness constraint demanding identity in anteriority between input stridents and their output correspondents below the agreement constraint assures that whatever the input, the outputs satisfy the agreement constraint. The failure of loanwords to conform to this distribution pattern leads to divergence between the loan stratum and the native stratum. Since this failure is a consequence of the loan items being faithful to their form in the source language, faithfulness constraint that features in the native stratum is differentiated with respect to the loan stratum. Hence the IDENT-SOURCE(anterior) constraint. The constraint is not indexed to the source language as loanwords from both Classical Arabic and Hausa fail to conform to the distribution of stridents in the native stratum. Ranking the IDENT-SOURCE(anterior) constraint above the hierarchy established for the native stratum assures a single constraint ranking that reflects the distribution of stridents in both strata. In the same vein the difference in the choice of strategy for improving high tone syllables without onsets in Yoruba required motivating DEP-SOURCE(C-Place), a constraint that is differentiated from DEP that features in the hierarchy that determines the choice of strategy in the native stratum. Ranking this above the hierarchy of the native stratum assures copying in the native stratum and epenthesis in the loan stratum.

It is not only stratal divergence that requires motivating loan faithfulness constraints. In cases of convergence as in syllabic simplification, the modification of the

loan inputs in the target language is only obvious by relating them to their forms in the target language. To do this, a relevant loan faithfulness constraint that regulates the relation between the loan input and its output in the target language is required. This is the case with the FAITH-SOURCE(Coda) constraint whose ranking below the markedness constraint against codas leads to the modification of such forms in the target language. Though the constraint may not be a differentiated version of a faithfulness constraint in the hierarchy of the native stratum, its presence leaves open the possibility of the forms failing to undergo any modification. In such a situation it is ranked above the hierarchy of the native stratum. In addition, loanwords from different languages may be treated differently with respect to syllabic simplification requiring indexing the constraint to such sources. This exact situation arises in Nupe as I show in the next section. However motivating differentiated loan faithfulness constraints and ranking them above or below the hierarchy of the target language assures a single constraint ranking for the phonological phenomenon under consideration.

## 6.2 *Loan stratum heterogeneity*

The loan stratum comprises lexical items from different languages. In motivating loan faithfulness constraints the heterogeneity of the loan stratum is not reflected. Thus the various sources of the lexical items that constitute the loan stratum are not distinguished. To the extent that these items conform or fail to conform to the structure of Nupe, distinguishing the various sources of the loanwords is not required to account for the phenomenon in question. However it may happen that loanwords from different sources conform differently to the structure of the target language. Specifically, while some loanwords from one language are modified to conform to the structure of the target

language ensuring convergence, loanwords with a similar structure from another language may not be modified. This engenders divergence between the native and loan strata and within the loan stratum. In this case the relevant loan faithfulness FAITH-SOURCE constraint is indexed to the language from which the divergent forms originate. This is then ranked accordingly in the subhierarchy that accounts for the phenomenon in question.

In discussing the syllable structure of Nupe, it was established that syllables with codas are not attested in the language. Loanwords from Classical Arabic with coda consonants are modified by parsing the coda into a separate syllable. The new syllable has as nucleus a vowel copied from the syllable to which the coda consonant was a part. This does not seem to be the case with loanwords from Hausa with coda consonants. They may be realized in Nupe without any modification. The data in (65) show that this is indeed the case.

(65) *Unsimplified syllables in loanwords from Hausa*

<u>Hausa</u>		<u>Nupe</u>	<u>Gloss</u>
hár	→	hár	‘until’
fárkó:	→	farko	‘first’
gàskijá:	→	gàskija	‘truth’
fúskà:	→	fúska	‘face’
káskó	→	kasko	‘shallow pot’
háské:	→	háske	‘light’
kúskùrè:	→	kúskùrè	‘mistake’

Observe that the coda consonants are coronal. This suggests that coronals might be tolerated in coda position, especially since they are the least marked for place features. Though this is plausible, it does not generalize to coronals occurring in the same position in loanwords from other languages. Some examples from Classical Arabic in (45) contain coronal consonants in coda position, and they are modified accordingly. In addition, the Hausa examples might suggest that only coronals occur as codas. This is not the case other consonants occur as codas as in the examples in (66).

(66) *Codas other than coronals in Hausa*

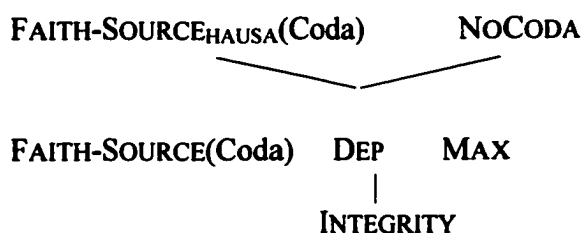
dàbgí	‘ant-eater’
tsáptà	‘cleanliness’
tsáf	‘completely’
tʃák	‘fully’
hàmsín	‘fifty’

It must be pointed out that the forms in (65) are alternatively realized with epenthetic [i]. This alternative is indication that codas of loan inputs do undergo modification, albeit with different strategies. This engenders two kinds of variation that I discuss in chapters three and four. One is intralinguistic typological variation, and the other is optionality. I return to the first at the relevant point in chapter three. The second I address shortly. The question arises as to why the codas from Hausa loans are tolerated while those from other sources are not. Hyman (1973:448) attributes this to the Nupe speakers’ awareness of the historical origin of the words. He adds that others insert a short [i] without palatalizing the [s], and that the less contact a Nupe has had with Hausa, the more likely he is to fully nativize these forms by palatalizing the [s]. The first

observation should generalize to all loans since at the point of contact between languages the speakers of the borrowing language are aware of the language from which borrowing is taking place. This informs the formulation of the loan faithfulness constraints such that the source languages are not discriminated. The different levels of awareness and contact are not easily encoded in constraints. However, of the options noted by Hyman, the full nativization with palatalization never seems to occur. Recall the discussion on strident distribution in the loan stratum in §3.2.

In order to account for the optional modification of loanwords with coda consonants from Hausa, the loan faithfulness constraint FAITH-SOURCE(Coda) has to be indexed with Hausa as in FAITH-SOURCE<sub>HAUSA</sub>(Coda). Since the loanwords may be modified with epenthetic [i], the constraint has to be ranked with the NOCODA constraint so as to allow for this option. Anticipating the discussion on optionality in chapter four, FAITH-SOURCE<sub>HAUSA</sub>(Coda) and NOCODA are crucially unranked with respect to each other. The indexed constraint is thus integrated into the syllabic simplification subhierarchy in (47) resulting in the modified subhierarchy in (67).

(67) *Modified syllabic simplification subhierarchy*



The modified subhierarchy (67) reflects the fact that Nupe may or may not allow codas in loanwords from Hausa (FAITH-SOURCE<sub>HAUSA</sub>(Coda), NOCODA), while codas from languages other than Hausa are not allowed (NOCODA » FAITH-SOURCE(Coda)).



Loan stratum heterogeneity is captured by constraint indexation. Indexation is only required when loanwords from different languages react differently to the constraints that govern the native stratum. Constraint differentiation, indexation, and ranking thus suffice to indicate the areas of convergence and divergence between the native and loan strata. These mechanisms ensure that the lexicon of a language derives from a single constraint hierarchy. The resulting hierarchy with differentiated and indexed FAITH-SOURCE constraints has implications for learnability. These implications are examined next.

### *6.3 Implications for learnability of differentiated and indexed constraints*

According to Tesar and Smolensky (1999) learning in OT consists of learning the ranking of constraints. Other components of the grammar such as full structural descriptions and overt structure play a role in the learning process. The learning procedure is such that the learner uses a grammar to interpret overt forms by imposing on them the best structural descriptions according to the current ranking. These descriptions are then used in learning. Since the goal of the learner is to arrive at the correct ranking of the constraints, he starts out with a hypothesized initial ranking of the constraints that are provided by UG to evaluate observed overt forms. The assigned structures are used to change the ranking resulting in a new grammar. The new ranking is used to assign new full descriptions to overt forms, a process that is repeated till the correct ranking is converged upon. At the point of convergence, the overt structures will indicate that the ranking is correct and no further change is required.

Central to the learning process, that is the convergence upon the correct ranking, is the principle of Constraint Demotion. This relies on the inherent comparative nature of

OT to the effect that the grammaticality of a structural description is determined with respect to competing candidates. A grammatical structure forms a data pair with a competing candidate. The correct ranking must make the grammatical structure (*winner*) more harmonic than its ungrammatical competitor (*loser*). What the learner then needs to do given a set of loser/winner pairs is to find a ranking that makes each winner more harmonic than its corresponding loser. This is where Constraint Demotion kicks in by demoting the constraints violated by the winner down the hierarchy so that they are dominated by the constraints violated by the loser.

The learning procedure outlined above assumes that the language learner is dealing with overt data from his own language. The challenge of loan phonology for learnability is that the learner receives data from languages other than his own. This is assuming that the forms that are being dealt with are those that have not been borrowed by earlier generations. I address the issue of loans handed down from preceding generations in §8. The data might contradict the generalizations that he has arrived at by the current ranking. Modifying the hierarchy to assign the correct structural description may lead to a loss of generalization. The learner can do one of two things, modify the structure to suit the ranking, or identify a new set of generalizations that assign the correct grammatical description to the overt structures. The first option ensures that the full structural descriptions are consistent with the current ranking, while the second option requires a ranking that is inconsistent with the current ranking.

Crucial to the learning algorithm developed by Tesar and Smolensky is the stratified hierarchy. The stratified hierarchy is such that constraint sets fall into different strata with the constraints in each stratum not ranked relative to one another but with each

dominating the constraints in the lower stratum. The domination relation specified in constraint ranking is a special case of the stratified hierarchy where each stratum consists of just one constraint. Learning consists of establishing an initial hierarchy with all constraints ranked in the top stratum. Constraint Demotion is then applied to informative positive evidence till the process converges on a stratified hierarchy such that all totally ranked refinements of the hierarchy correctly account for the learning data. To reckon with the fact that data may be coming from languages other than that being currently learned, the initial hierarchy should include a constraint that encodes this fact. In the preceding analysis, the constraint is generally FAITH-SOURCE. It is differentiated with respect to some faithfulness constraint of the target grammar. Once the relevant loan faithfulness constraint is established in the initial hierarchy, it can be ranked accordingly as required by the observed overt structure. The constraint is deployed when the learner encounters data inconsistent with an established ranking. The learner's task is to classify the data into those that are native to the language that he is learning and those that are not. Assigning a grammatical description to the second set of data that is consistent with the ranking established for the first set of data requires demoting the loan faithfulness constraint below the other constraints. This results in maintaining the generalization achieved by the established ranking. In the event that the assigned description is ungrammatical, but consistent with the generalization otherwise established, the constraints that capture this generalization are demoted below the loan faithfulness constraint. This way the learner not only arrives at a hierarchy that accounts for all of the learning data, but one that captures the fact that the grammar can be coextensive with that of another language. On the whole the hierarchy arrived at correctly accounts for the

grammar of the target language no matter the number of sources that the lexicon is drawn from. The mechanisms of constraint differentiation and indexation are mnemonic devices for keeping track of the constraints of the native stratum satisfied or violated by the loan items and the sources of the loanwords respectively. This way the hierarchy illustrates the areas of convergence and divergence between the native and loan strata and the heterogeneity of the loan stratum.

Lexical stratification and its modeling in OT is the subject of several works by Itô and Mester. These include Itô and Mester 1995ab, 1999, and 2000, among others. These address in particular the Japanese lexicon and loan nativization phenomena in general. The approach to lexical stratification is built around a core-periphery organization of the lexicon. A model that argues for a different approach to the Japanese lexicon, and hence the resulting model of lexical stratification is the multiple faithfulness model proposed in Fukazawa 1998, and Fukazawa, Kitahara & Ota 1998. I review these two approaches in the next section and show how they compare with the approach argued for here.

## **7. Constraint-based Approaches to Lexical Stratification**

I review the core-periphery model of the lexicon proposed in Itô and Mester 1995ab, and subsequent developments of this basic model (Itô and Mester 1999, 2000, among others), and point out problems with it, problems that the approach developed here do not seem to have. Some of these problems have also been identified in Fukazawa 1998, and Fukazawa, Kitahara, & Ota 1998. The alternative approach developed by the latter, the multiple faithfulness model is also examined and its inadequacies identified.

### 7.1 *Core-periphery model of lexical organization/stratification*

The approach to lexical stratification developed by Itô and Mester within the constraint-based OT is based on strata identified for the Japanese lexicon. The basic idea is to organize the constraints that define the Japanese phonology and have them apply in different domains defined by the identified strata that make up the lexicon. The effects of the constraints are different across the strata. While some are restricted to a particular stratum, others overlap different strata. Of particular interest is that these constraints (especially in the 1995a paper) are markedness constraints. The different effects of the constraints result in organizing the lexicon into a core-periphery structure. The core is governed by the maximum set of lexical constraints, and as there is movement outwards to the periphery, these constraints cease to be effective or are weakened systematically. The overall effect of this on the compliance of lexical items with the lexical constraints is that native items constitute the core and they obey all the lexical constraints, while less nativized items may be exempt from some of these lexical constraints. They are thus located toward the periphery. The markedness constraints that govern the Japanese lexicon are SYLLSTRUC, NOVOIGEM, NO-[P], and POSTNASVOI. The recognized strata include Yamato (native), Sino-Japanese, Foreign, and Unassimilated Foreign (Alien). While the Yamato stratum satisfies all the constraints, the Sino-Japanese stratum satisfies all but POSTNASVOI, the Foreign Stratum satisfies only SYLLSTRUC and NOVOIGEM, and Alien satisfies only SYLLSTRUC. This pattern of constraint violation relative to each stratum organizes the lexicon into domains with the constraints having a hierarchical inclusion relationship. Thus the most violated constraint POSTNASVOI is the innermost, nesting this is the next most violated constraint NO-[P], which is in turn nested by

NOVOIGEM, with the outermost nest being SYLLSTRUC, the constraint that is satisfied by all the strata. This implies that everything that is subject to an inner constraint is subject to the one outside it but not vice versa. This organization entails that there is a core area of the lexicon where all constraints are satisfied and a periphery where fewer constraints are satisfied. This basic idea developed in Itô and Mester 1995a, has undergone some refinements and has come to be viewed more recently as a superset-subset, or set inclusion structure of lexical inventories (Itô & Mester 1999, 2000).

Whichever version of the model is considered the problems are essentially the same. The first is with the core-periphery structure that is attributed to the lexicon. Fukazawa, Kitahara, and Ota argue that this is a mere tendency in the Japanese lexicon and not an inherent property of the grammar. The arguments against this view of the lexicon are first, the subset-superset relation that has to hold for a strict core-periphery structure to be maintained may not hold between the different strata. For instance, according to Fukazawa, Kitahara, and Ota, Yamato words are subject to both POSTNASVOI and NO-[P] and Sino-Japanese words are only subject to NO-[P], while Mimetics are exempt from NO-[P], but subject to POSTNASVOI. Were the subset relation to hold between the three, Sino-Japanese and Mimetics should stand in the same relation to Yamato satisfying only one of the two constraints that hold for Yamato.

Second, the overlap between different strata with respect to some restrictions calls into question the core-periphery structure attributed to the lexicon as the different strata stand in relations not along the core-periphery dimension. For example, the prosodic size restrictions on roots or stems holds only for Mimetics and Sino-Japanese but not for the other strata (cf. Hamano 1986, Tateishi 1989).

Third, there exist counter-examples to the core-periphery structure as evidenced in the analysis of permissible intra-syllabic phonology of each stratum. The segmental patterns within a heavy syllable closed with moraic nasal overlap strata, and do not therefore exhibit a core-periphery structure. These drawbacks lead Fukazawa, Kitahara, and Ota to the conclusion that the core-periphery structure does not derive from an inherent property of the grammar. They however admit that this is a tendency that results from an assimilation process involved in the formulation of loanword lexicon.

Besides the problems identified with the core-periphery model organization of the lexicon by Fukazawa, Kitahara, and Ota, there are other reasons to fault the model in all its incarnations. In the first appearance of the model (Itô & Mester 1995a), the core-periphery structure is based on the relative ranking of the markedness constraints that govern the Japanese lexicon. The relative ranking of these markedness constraints is determined by how the different strata satisfy each constraint. The effect is that the constraint satisfied in every stratum ranks the highest. As the number of strata that satisfies a constraint decreases, its place in the hierarchy diminishes. This architecture runs through all developments of the model. Thus the ranking of the constraints is as in (68).

(68) *Ranking of markedness constraints of the Japanese lexicon* (cf. Itô & Mester 1995b)

SYLLSTRUC » NOVOIGEM » NO-[P] » POSTNASVOI

The problem with the architecture for ranking the markedness constraints is that there seems to be no evidence for the ranking other than their satisfaction relative to each stratum. Thus for example there is no evidence for the ranking SYLLSTRUC »

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NOVOIGEM other than that while all the strata satisfy SYLLSTRUC, NOVOIGEM is satisfied in all but one stratum. In subsequent developments it is assumed that different degrees of nativization determine the ranking of markedness constraints. The major flaw with this approach is that the phenomena captured by the markedness constraints appear to be independent of each other. Thus while SYLLSTRUC is a constraint on syllable well-formedness, NOVOIGEM prohibits voiced geminates, two unrelated phenomena. For this reason ranking the markedness constraints either way may not be crucial. Rather the relations that need to be indicated are those between faithfulness and markedness constraints. In the case of SYLLSTRUC it should be the improvement of input ill-formed syllables while for NOVOIGEM it should be the modification of input voiced geminates. These require the involvement of faithfulness constraints. The original model is silent on the role of faithfulness constraints, but this is addressed in subsequent developments.

The introduction of faithfulness constraints into the scheme of things (Itô & Mester 1995b) attributes lexical stratification to the reranking of faithfulness constraints while holding the ranking of markedness constraints constant. In this case the relevant faithfulness constraints MAX and DEP are collectively referred to as FAITH. To determine the extent to which each stratum satisfies the markedness constraints FAITH is interposed at different points in the hierarchy. The hierarchy in (68) is held constant but five points are created into which FAITH can move and thus determine the relative ranking for each stratum as indicated in (69).

- (69)    \_\_ » SYLLSTRUC » \_\_ » NOVOIGEM » \_\_ » NO-[P] » \_\_ » POSTNASVOI » \_\_  
           (e)                      (d)                      (c)                      (b)                      (a)



Despite Itô and Mester's stated goal of deriving the entire lexicon from a single constraint hierarchy the final result is that the rankings are still stratum-specific with FAITH ranked accordingly in each stratum, hence Yamato, Sino-Japanese, Foreign, and Alien rankings. At no point is there a single ranking that characterizes the entire Japanese lexicon. Once again there is no explicit evidence for the markedness hierarchy relative to which FAITH is reranked in each stratum.

Itô and Mester's latest efforts (Itô & Mester 1999, 2000) address the issue of a single ranking characterizing the Japanese lexicon. The concept of FAITH-differentiation is introduced with the result that FAITH is relativized to the stratum (Faith/Native, Faith/Sino-Japanese, Faith/AssimilatedForeign, and Faith/UnassimilatedForeign) and interpolated at different points in the fixed markedness hierarchy. This makes it possible for a single constraint hierarchy to define the Japanese lexicon, and generally to capture lexical stratification. There is a further demonstration of the interaction of specific faithfulness constraints with the relevant markedness constraints with respect to some phonological phenomena in Japanese and instantiated in each stratum. For example the ban on doubly voiced obstruents in a stem (Lyman's Law) is explained by the interaction of the faithfulness constraint  $\text{Ident}[\text{voi}]$  and the markedness constraint  $\text{NoVoiObs}^2_{\delta}$ , where  $\delta = \text{stem}$ . The ranking  $\text{Ident}[\text{voi}] \gg \text{NoVoiObs}^2_{\delta}$  holds for the native stratum. But the presence of doubly voiced obstruents in loanwords requires relativizing  $\text{Ident}[\text{voi}]$  to the relevant stratum. Thus, for instance,  $\text{Ident}[\text{voi}]_{\text{Foreign}}$  dominates  $\text{NoVoiObs}^2_{\delta}$ . Consequently each faithfulness constraint is indexed with the stratum. This introduces multiple faithfulness constraints each indexed with the source and standing in different relations with the relevant markedness constraint. This is similar to what I did for Hausa,

except that it is with respect to loan stratum heterogeneity, and not the relation between the native and nonnative strata.

Though constraint indexation captures the divergence between the native and nonnative strata, it fails to capture the generalization that the nonnative stratum may behave uniformly with respect to the relevant phenomenon regardless of the source of the items. This is as I have shown in the analysis of the distribution of stridents in loanwords from Classical Arabic and Hausa in Nupe. The proliferation of indexed faithfulness constraints is avoided by having the relevant FAITH-SOURCE constraint encode the dimension of faithfulness for which nonnative words differ from the native ones. Only when the nonnative items behave differently is the source language identified. This way the fact that the nonnative stratum may behave uniformly with respect to the phonology of the native stratum is captured. In effect, ranking the relevant FAITH-SOURCE constraints with respect to the markedness constraints that the nonnative items satisfy or violate indicates whether loans conform or fail to conform to the structure of the target language. In addition the indexed faithfulness approach misses the point that in loanword adaptation what is at issue is not so much a satisfaction or violation of a faithfulness constraint of the source language but superordinating or subordinating the loan faithfulness constraint to the hierarchy of the target language.

The introduction of stratum-specific faithfulness constraints leads to the motivation of another concept with respect to the relation between the faithfulness constraints, namely ranking consistency. As with the fixed ranking of markedness constraints the faithfulness constraints also have a fixed ranking. Ranking consistency demands that the relative ranking of a set of faithfulness constraints and their stratal

instantiations be invariant across strata. The goal is to have the various stratum-specific faithfulness constraint ‘tokens’ collapsed into a consistently ranked hierarchy of faithfulness ‘types’. The question arises as to whether the stratum-specific faithfulness constraints need to be ranked with respect to one another. Since lexical items constituting the nonnative stratum are not related to each other but to the items of the native stratum, the crucial ranking relations that need to be captured are those between the nonnative stratum-specific constraints and constraint hierarchy of the native stratum. Any relations between the stratum-specific constraints is thus a consequence of a property of constraint ranking, namely transitivity. Furthermore, in the discussion of markedness improvement strategies for syllable-tone interaction in Yoruba (§5) the ranking between the faithfulness constraints DEP and INTEGRITY is DEP » INTEGRITY for the native stratum. If this is instantiated for each stratum, the ranking for the loan stratum will be INTEGRITY » DEP. This leads to a ranking inconsistency across strata. Ranking consistency may thus not be a factor in lexical stratification. The pertinent issue in lexical stratification is that forms coming into a language may be subject to the constraints of the target language and by so doing differ in the structure in the source language. When they keep their forms from the source language they violate the constraints of the target language. The relative ranking of the relevant loan faithfulness constraint captures this. On the whole the core-periphery model of lexical organization achieves the goal of deriving the lexicon from a single constraint hierarchy. But the principles by which it does so—fixed markedness hierarchies, stratum-specific faithfulness constraints, fixed faithfulness hierarchies, and ranking consistency—obscure the independence of phonological phenomena, the uniform behavior of nonnative items with respect to the phenomena that characterize the native

stratum, and the generalization that stratal convergence and divergence follow from subordinating or superordinating loan faithfulness constraints to the hierarchy of the target language. The multiple faithfulness approach designed to address the inadequacies of the core-periphery model of lexical stratification does not appear to fare better with respect to these issues. I discuss that approach next.

## 7.2 *Multiple faithfulness model of lexical stratification*

The multiple faithfulness model of lexical stratification (Fukazawa 1998, Fukazawa, Kitahara & Ota 1998) is an alternative to the core-periphery model, and is as well based on the Japanese lexicon. Its aim is to account for lexical stratification using a single invariant constraint ranking, contra the core-periphery model that allows for reranking according to the stratum. As pointed out in the preceding section the proponents of the multiple faithfulness model claim that the core-periphery structure of the lexicon is not an inherent property of the grammar but a mere tendency. It is therefore proposed that projecting multiple faithfulness constraints can derive the effects of lexical stratification. These are ranked with other constraints in a single hierarchy that represents the grammar of the Japanese language.

The multiple faithfulness model is based on Correspondence Theory (McCarthy & Prince 1995) which recognizes different kinds of faithfulness relations. On the assumption that the Japanese lexicon consists of five strata—Yamato(Y), Sino-Japanese(SJ), Mimetics(M), Foreign(F), and Alien(A)—the model instantiates five Input-Output faithfulness relations, one for each stratum. Each IO-FAITH constraint required by the grammar is multiplied across strata. Thus for instance, if there are instantiations of the correspondence constraints MAX, DEP, and IDENT with respect to any phonological

token, say [voice], there will be fifteen ( $3 \times 5$ ) such constraints in Japanese. These are ranked with respect to one another and the markedness constraints that define particular phonological phenomena, for example postnasal voicing (PNV). The rankings are then unified into a single constraint hierarchy that explains the grammar of Japanese. Though the model achieves an invariant ranking for the grammar it is fraught with problems. But first its merits.

Unlike the core-periphery model, the multiple faithfulness model maintains the independence of the phonological phenomena that define the lexicon of Japanese. In this respect there is no fixed markedness hierarchy within which the multiple stratum-specific IO-FAITH constraints are interpolated. It is thus able to show that there is no evidence for the rankings between the markedness constraints used to justify the core-periphery structure of the grammar. It also presents a clearer picture of the behavior of the various strata with respect to each phonological phenomenon. In addition, the model solves the ranking paradox problem that interstratal variation brings about. In this case, where a potential paradox arises in the face of contradictory data, a faithfulness constraint that refers to the data is projected and ranked accordingly.

Despite the merits of the multiple faithfulness model noted above, it has a number of drawbacks. First, the propagation of multiple faithfulness constraints does not make for economy of analysis. In as much as it is desirable to have a single constraint hierarchy for the grammar of a language the presence of stratum specific IO-FAITH constraints for each possible IO correspondence relation can make the system unwieldy. To the extent that each stratum can have its own set of faithfulness constraints, it should be able to have a corresponding set of markedness constraints, especially since grammars are determined

by the interaction of faithfulness and markedness constraints. In this case the markedness constraint PNV can be instantiated for each stratum and should interact accordingly with the corresponding faithfulness constraint. The logical consequence is that the phonology of each stratum is independent of the other. The model does not rule out this in principle, though it advances a mechanism for constraining the propagation of faithfulness constraints. I return to this issue shortly.

Second, the model accords equal status to the lexical strata, and thus loses sight of the fundamental issue of lexical stratification. By having stratum-specific IO-FAITH constraints, the distinguishing properties of the target grammar may be obscured. The constraint ranking that defines the target grammar and establishes it as different from other grammars should be discernible from the overall ranking that takes into consideration stratal divergence and convergence. The relevant issue then is in what ways the strata differ with respect to the distinguishing characteristics of the target grammar. Lexical stratification is thus a product of the compliance or noncompliance with these characteristics by items that originate from other sources. The multiple faithfulness model obscures the constraint interaction that gives a grammar its distinctness. For example post nasal voicing in Japanese changes an input voiceless obstruent before a nasal consonant into a voiced obstruent leading to a difference in identity between the input and output. This is due to the ranking PNV » IDENT[voice]. In loanwords with voiceless obstruent-nasal sequences the obstruent is not voiced. This suggests that the opposite ranking holds in these languages. The failure of PNV in these loans is therefore a result of subordinating the Japanese hierarchy to the relevant loan faithfulness constraint.

Furthermore the model fails to capture the uniform behavior of some of the strata with respect to particular phonological phenomena, though this is superficially reflected in grouping the various IO-FAITH constraints together at the same point in the hierarchy. In this regard the fact that Sino-Japanese, Foreign, and Alien lexical items do not conform to the PNV is achieved by ranking IDENT[voice]-IO-SJ, IDENT[voice]-IO-F, IDENT[voice]-IO-A above PNV. This is a redundancy that can be avoided by collapsing these into a single loan faithfulness constraint, IDENT-SOURCE[voice] following the general loan faithfulness constraint schema, FAITH-SOURCE, that unifies the nonnative stratum proposed in my analysis of loan phonology. Differentiated constraints thus interact with the hierarchy that defines the grammar of a language to determine whether nonnative items, whatever their origin, conform or fail to conform to the structure of the language. It is this interaction that any model of lexical stratification should strive to capture. By allowing the proliferation of faithfulness constraints, the multiple faithfulness model fails to attain this ideal.

The proponents of the multiple faithfulness model recognize a potential problem with the model, excessive multiplication of faithfulness constraints. Two learning procedures are proposed to constrain the propagation of faithfulness constraints. The first is a data-driven mechanism which projects and restricts multiple faithfulness constraints, while the second is an evaluation metric which computes the fewest number of strata necessary to account for the target data pattern. The first procedure proposes that a faithfulness constraint be split and ranked independently if and only if there is no other way of resolving a ranking paradox posed by ambient data. This procedure has the intended restrictiveness but inherently contradicts the number of lexical strata recognized

a priori. There may not be a one-to-one match between the faithfulness constraints and the number of strata. This is especially so if data that otherwise come from different sources do not show any difference in behavior with respect to a given phonological process. Five strata are recognized for the Japanese lexicon a priori. But for postnasal voicing, it is the case that Sino-Japanese, Foreign, and Alien on one hand, and Yamato and Mimetics on the other hand behave uniformly with respect to this phenomenon. This suggests that only two strata and hence two IO-FAITH constraints need be recognized based on the data. The procedure also has the unintended consequence of splitting a unique stratum into several different strata. The potential for intrastratal variation engenders this possibility.

The second procedure is designed to project the exact number of lexical strata needed in the target grammar. This is achieved by generating the minimum number of faithfulness constraint sets necessary to account for all ranking differences. Each lexical item is indexed to a set of faithfulness constraints, and each time that there is some input data inconsistent with an established ranking of these constraints, a new set of faithfulness constraints is generated by the grammar. If not, all lexical items are assumed to be associated with one of the already established sets. The faithfulness constraints are eventually indexed to a group of lexical items that then form different strata. In the final analysis the stratum-specific rankings are unified into a single constraint hierarchy of the language. As with the first procedure there may be no convergence between the resulting strata and the strata established a priori.

The core-periphery and multiple faithfulness models of lexical stratification have been shown to be inadequate for meeting the fundamental tenet of deriving the grammar



of a language from a single constraint hierarchy. Compared with the model proposed here, they fail to adequately capture the fact that interstratal variation is a product of the failure of nonnative items to conform to the structure of the target language. The nonnative items thus constitute a homogenous whole in this respect. Only when they behave differently with respect to a particular phenomenon is it necessary to relativize the relevant loan faithfulness constraints to the source of these items. Ultimately, only a native stratum and a nonnative stratum need be recognized in the grammar of particular languages. This approach makes for analytical economy and the constraint system required to achieve the desired result is less cumbersome. Next I address some sundry issues in lexical stratification and loan phonology in general.

## **8. Sundry Issues**

This section is an excursus on a number of issues in loan phonology featured in the literature or fallout of the analysis presented here. These include what qualifies as a loan, input to loan phonology, loan-specific phonology, stratal constitution, degrees of nativization, and knowledge of source language.

### **8.1 Loans**

The discussion of loan phonology requires a definition of loanwords as against other possible tendencies that arise from language contact situations. The difference between loanwords and these other tendencies are put in perspective in Poplack et al. (1988). A loanword is defined vis-à-vis the distinction between the source language (L2) and the target language (L1) (Paradis & LaCharité 1997's adaptation of Poplack et al. 1988). In this regard Paradis and LaCharité define a loanword as an L2 word that is incorporated into L1, has a mental representation in L1, and is made to conform to at least the

outermost peripheral phonological constraints of L1, which represent absolute constraints of L1 (assuming a core-periphery structure of the lexicon (cf. Itô & Mester 1995a and subsequent work), and the constraint-based Theory of Constraints and Repair Strategies (TCRS) (Paradis 1988ab, 1990, 1993, Paradis and Prunet 1988, Paradis and LaCharité 1993, and Paradis et al. 1993). Loanwords are thus distinguished from nonces (borrowings produced once by a bilingual) and idiosyncrasies (non-established borrowings used repeatedly by one bilingual), and code switches (L2 vocabulary used in L1 discourse by a bilingual). Against this backdrop established loanwords are those borrowings used throughout the linguistic community by both bilinguals and monolinguals. It is these that should be the focus of phonological analysis, though the others are vehicles for introducing loans into L1.

Paradis and LaCharité correctly capture the features of loanwords, except in respect of the conformity pattern. I have argued against the core-periphery model of the lexicon and the attendant constraint weakening idea as the periphery is approached. The relative ranking of constraints in L1 is not a product of loanword adaptation, but an effect of its overall phonology. Loanword adaptation is thus a product of the conflict between respecting the constraints of L1 and remaining faithful to the constraints of L2. This may sometimes be resolved in favor of L1, ensuring convergence, or in favor of L2 introducing divergence, and thus engendering interstratal variation. It is this convergence or divergence that is of theoretical import, and it is what I have attempted to explain in the foregoing sections.

## *8.2 Input to loan phonology*

There are two contending views on the input to loan phonology. The views have to do with what L2 string the L1 speaker perceives and adapts accordingly and the factors that model the adaptation. Silverman (1992) presents a model of loanword phonology that recognizes two levels of representation, the Perceptual Level and the Operative Level. The input of the Perceptual level of L1 is a superficial acoustic signal that lacks a phonological representation. The constraints of L1 assign phonological structure to the acoustic signal. The resulting structure is then submitted to phonotactic constraints at the Operative level, triggering phonological processes that make the input conform to sequential constraints resulting in the output satisfying all the constraints of L1. In this model some processes are considered negligible and this leads Silverman to conclude that native and loanword phonology are distinct. Though the model is rule-based, it is adapted in an early account of loanword phonology in Optimality Theory (Yip 1993). Though Yip adapts this model she rejects the notion of keeping native and loanword phonology distinct. I return to this issue shortly.

The multiple scansion model of loanword adaptation is shown to be inadequate for a number of reasons by Paradis and LaCharité (1997). The Perceptual level is rejected for its redundancy, contradictions, incompatibility with psycholinguistic and sociolinguistic studies, and the assumptions underlying it are falsified by social conventions (see Paradis and LaCharité 1997:418-423 for details). Of particular interest is the claim that the input lacks a phonological structure. Paradis and LaCharité hold the view that since bilingual speakers are the importers and adapters of loanwords, they must have access to the phonological structure of L2. It is the structure that is subject to the

constraints of L1 to give the ultimate form in L1. This informs Paradis and LaCharité's model of loanword phonology within the TCRS framework. However language and cultural contact situations engender borrowings, and the importers and adapters need not be bilinguals.

The model of loanword integration proposed by Paradis and LaCharité recognizes a direct link between L2 and L1. The dictionary of L2 is subject to phonological constraints effective at lexical and postlexical levels that determine the output of L2. This phonological output is directly incorporated into the dictionary of L1, even though it may contain malformations in L1's view. It is then subjected to the phonological constraints, lexical and postlexical, resulting in the observed phonetic output. It is assumed that the input into the L1 dictionary does not contain any redundant information from the perspective of L1 except if such information is highly characteristic of L2. In the foregoing discussion of loan phonology I have adopted this view in characterizing the input to loan phonology by taking the output of L2 as input without predictable redundant information. Since the OT framework has no place for levels, the constraints that are active in the phonology of L2 may also be active in the phonology of L1 given the universality of constraints, differences being due to language-specific rankings. This much is recognized by Paradis and LaCharité as they argue against keeping the native and loan phonology distinct since the constraints that govern loan phonology hold as well in L1 phonology. In the OT framework assumed in the present work the lexicon of L2 is subject to its constraint hierarchy and the output is the input to the L1 dictionary where it is subject to the constraint hierarchy of L1 to give the optimal output.

### *8.3 Loan-specific phonology*

In the preceding section, it was pointed out that loan phonology is kept distinct from native phonology in the model of loanword integration proposed in Silverman 1992. Yip (1993) and Paradis and LaCharité (1997) reject this position for different reasons. Paradis and LaCharité attribute the mistaken notion of distinguishing native and loan phonology to the view that loan adaptation processes are rules. Since these rules are triggered by borrowing and are otherwise not visible in the phonology of L1, the impression is created that they are specific to loan phonology, which is then separate from native phonology that does not manifest these rules. The constraint-based approach of Paradis and LaCharité eliminates this distinction by regarding adaptation processes as responses to (repairs of) constraint violations. In this regard, if the content of a repair is determined by a violated constraint, then a constraint has to be violated for a repair to be triggered. Paradis and LaCharité claim that this position closely follows that of Yip (1993). However there is a significant difference between the two positions despite their converging on eliminating loan-specific phonology.

Yip rejects loanword phonology as a separate component of the grammar and attributes the difference between loan items and their equivalents in the source language to subjecting the nonnative inputs to the well-formedness constraints on native vocabulary items. Since her analysis is based on the emerging Optimality Theory she categorically denies the existence of phonological rules. Instead she argues that the phonological component consists of a set of ranked universal constraints whose interaction determines the output of loanwords. In this regard there is nothing special about loanword phonology as processes that appear to be loanword-specific are so

regarded because there are no comparable processes in the native phonology. This Yip regards as an artifact of the lack of inputs for which such processes are needed. She then makes the important observation that adjustments to loanwords occasioned by the fact that they come with one set of well-defined conditions from one language to one with a different set are minimal, as the speaker is trying to keep the word as close to its original form as possible.

The observation by Yip underlies what any formal account of loan phonology ought to capture, resolving the conflict between remaining faithful to the constraints of the source language and complying with those of the target language. Though Yip's account does not reflect this resolution she motivates a general FAITHFULNESS constraint that demands that there be no alteration to the underlying form. The constraint applies equally to native as well as loan forms and interacts with other constraints to determine the optimal output of native vocabulary items and loanwords. As noted earlier, the analysis of loan phonology undertaken here reflects the spirit of Yip's observation by motivating loan faithfulness constraints that may be conceptually interpreted as encoding the well-formedness conditions of the source language. In effect it is this attempt to be faithful to this hierarchy and satisfying the hierarchy of the target language that leads to observed adjustments of loanwords—and nonadjustments in some instances—as have been demonstrated in the foregoing sections. It is important to point out that Yip's observation does not directly reflect the fact that the difference between languages is in the ranking of universal constraints. It can of course be argued that well-formedness conditions are a product of constraint interaction. In this respect the languages involved do not have a different set of constraints but a different ranking of these constraints. The

adjustments are made or not made by subordinating or superordinating L2 faithfulness constraints to the hierarchy of L1.

#### 8.4 *Stratal constitution*

The stratified structure of the lexicon of natural languages as occasioned by the different etymological origins of the vocabulary items raises questions about characterizing such stratification. Earlier approaches include partitioning the lexicon into morpheme classes and labeling them with appropriate features as in the sublexicon model (McCawley 1968). The other approach, the bifurcation model (Saciuk 1969), sees the lexicon as a branching tree diagram with the node labels [+homogeneous] and [-homogeneous]. The former groups together nonforeign lexical items while the latter groups together foreign items. The homogeneous node branches into other parts while the nonhomogeneous node does not. Itô and Mester (1995a) in proposing the constraint domains model and the resulting core-periphery organization of the lexicon identify the inadequacies of these earlier models. The important point of objection is that they give the impression that the various morpheme classes have independent phonologies. The recognition that there are systematic relationships among the different classes with the grammar remaining single and undivided is the basis for the constraint domains model. The resulting model still labels the strata by the existing labels for classifying the Japanese lexicon, namely, Yamato, Sino-Japanese, and Mimetic. In subsequent work Mimetic is omitted but Foreign and Alien are added. Fukazawa (1998) and Fukazawa, Kitahara, and Ota (1998) maintain the five lexical strata for the Japanese lexicon, including Mimetic. The issue raised by the models of lexical stratification is that of what makes a stratum, and how many strata need to be recognized in the lexicon of natural languages.

The point about lexical stratification is that the lexicon of natural languages consists of lexical items of origins other than those that are native to them. This partitions the lexicon into two natural classes, a native stratum, and a nonnative stratum to the extent that the foreign items are distinguishable from the native items. Though it might be worthwhile to identify the etymology of the items that constitute the nonnative stratum the goal of a constraint-based model of lexical stratification is to analyze the convergence and divergence between the native and nonnative strata with respect to phonological phenomena. This is made possible by establishing the constraint interaction that defines the native stratum, characterizing the nonnative stratum as a homogeneous whole, motivating a set constraints that capture this homogeneity (generally characterized as FAITH-SOURCE), and having these constraints interact with the hierarchy that defines the native stratum to ensure stratal convergence, or divergence (and the attendant interstratal variation), as the case may be. For the purposes of constraint interaction, only when the etymologically defined items constituting the nonnative stratum respond differently to the constraint hierarchy of the native stratum is the relevant loan faithfulness constraint relativized to the source language of the items involved. This implies that relativization can only be in respect of the source language, and not any other labels. In this regard whether the items constituting the nonnative stratum have been modified or not to conform to the structure of the native stratum may not obscure their identity as nonnative items. They may exhibit other structural properties that nonnative items never have. This has implications for the labels that have been used to characterize strata especially in the evolution of models of lexical stratification with specific reference to the Japanese lexicon.



In characterizing the Japanese lexicon the native stratum is labeled as Yamato. Other strata include Sino-Japanese comprising items of Chinese origin, Mimetic, Foreign comprising in large part assimilated English loans, and Alien comprising in large part unassimilated English loans. Of these labels only Yamato and Sino-Japanese reflect the origin of the items that constitute each stratum. Foreign and Alien comprise loans from English and need to be so labeled. The fact that some have been assimilated and others unassimilated should not obscure the fact that they have English origins. The assimilated loans are just those that conform to the structure of the native stratum with respect to some constraints, while the unassimilated are those that have not conformed to the structure of the native stratum with respect to the same or different constraints. In principle the same can be said of Sino-Japanese items, some may have been assimilated and others may not have been. Therefore the only relevant generalization that lexical stratification ought to capture is the extent of conformity of the nonnative items with the constraints that define the native stratum. Though there are language labels for the other strata there is no equivalent label for Mimetic. Mimetic can therefore not constitute a stratum, and is excluded with good reason from the lexical strata recognized in Itô and Mester's more recent work. Fukazawa and Fukazawa, Kitahara, and Ota maintain that it constitutes a stratum. Mimetics are native vocabulary items that exhibit peculiar phonological characteristics relative to other vocabulary items of the native stratum, and should therefore not constitute a separate stratum. Recognizing this as a stratum is akin to stratifying items that exhibit different phonological behavior. For instance, if in a language verbs exhibit peculiar phonological characteristics as different from nouns, then each must constitute a separate stratum. It is a fact of natural languages that lexical

categories are defined by certain characteristics (see chapter four for a discussion of such characteristics for Nupe lexical categories), but this does not lead to marking each category as a separate stratum. Stratal constitution is therefore based on the etymology of the lexical items, and not on the peculiarities exhibited by classes of lexical items.

### 8.5 *Degrees of nativization*

The extent to which items borrowed from other languages conform to the structure of the target language has been couched in terms of “degrees of nativization”. This has also been used to justify the fixed ranking of markedness constraints in Itô and Mester’s (2000) approach to lexical stratification, and to motivate implicational relations between loan adaptations. The interaction of the fixed hierarchy with stratum-specific faithfulness constraints has been used to motivate different degrees of nativization ranging from fully nativized, partially nativized, not nativized, to impossible nativization. These various effects are not determined by the fixed markedness hierarchy but by what constraints of the target language loans satisfy—the phonological phenomena they comply with, and those which they do not satisfy—the phonological phenomena that they fail to comply with, phenomena that may otherwise not be connected as they are accounted for by different constraint interactions. The implicational relations resulting from the notion of degrees of nativization do not seem to have any formal role in the account of loanword adaptation. Loanwords respond differently to the phonology of the target language in the attempt to mirror the hierarchy of the source language as much as possible while conforming to the hierarchy of the target language, and the relative ranking of the markedness constraints of the target language does not appear to be a determining factor.

### 8.6 *Knowledge of source language*

In describing loan faithfulness constraints as faithfulness to the source language, the question arises as to how much of the source language the speaker of the borrowing language is aware of. To the extent that borrowing takes place in language and cultural contact situations, the first generation borrowers are necessarily aware of the source language. The difference between the phonology of the source language and the target language is responsible for the modifications that the borrowings undergo. Once these become established in the target language they are passed down to later generations. These later generations may have no awareness of the source language. Nonetheless they know the phonology of the language well enough to discern items that do not seem to share the phonological patterns of the language despite having undergone some modifications. That these forms show a different phonology leads these later generations to assign them to different origins. In so doing they hypothesize some source language. Subsequently it is with respect to the hypothesized source language that the forms are related to their forms in the target language. It is around the hypothesized source language that loan faithfulness constraints are constructed. Since later generations have access only to the modified forms, FAITH-SOURCE is computed with respect to these forms.<sup>5</sup>

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<sup>5</sup> It is plausible to couch this in terms of sympathy theory (McCarthy 1998) to the effect that later generations have a sympathy derivation for loans where the assumed source is the flower candidate. As much as this is worth exploring further, I leave it for future research.

## **9. Summary**

The lexicon of natural languages consists of vocabulary items of different etymological origins in addition to those that are native to it. This partitions the lexicon into a native stratum and a nonnative stratum. Stratal convergence occurs when nonnative items with structures different from those of native items are modified to conform to the structures of the latter. Divergence ensues when nonnative items with ill-formed structures relative to native items are not modified to conform to the structures of the latter. This results in interstratal variation.

The approach to interstratal variation argued for in this chapter involved motivating loan faithfulness constraints that regulate loan inputs and their outputs in the target language. These are collectively characterized as FAITH-SOURCE. FAITH-SOURCE is differentiated in terms of correspondence constraints that regulate loan inputs and their outputs in the target language. A FAITH-SOURCE constraint may be relativized to the source language only if items from different languages are treated differently with respect to a phonological phenomenon of the target language. Ranking a loan faithfulness constraint above the hierarchy that regulates a phonological phenomenon in the native stratum results in the nonnative items retaining their forms from the source language. This leads to divergence between the loanwords and native items that are subject to the phenomenon. Divergence was illustrated with strident distribution in Nupe native vocabulary items and loanwords from Classical Arabic and Hausa. Convergence was illustrated with syllabic simplification of loanwords with coda consonants from Classical Arabic. The utility of loan faithfulness constraints was further demonstrated with respect to difference in the choice of markedness improvement strategy for onsetless syllables

arising from gerundial affixation in Yoruba and similar structures arising from adaptation of English loanwords.

The interaction of differentiated FAITH-SOURCE constraints with the hierarchy of the target language facilitated the construction of a model of lexical stratification that derives the grammar of natural languages from a single constraint hierarchy in spite of stratal differences. Constraint differentiation and ranking show the constraints of the target language that loanwords satisfy and those that they do not satisfy. The loan stratum is thus assumed to be homogeneous. If however loan items from different sources react differently to the same phenomenon in the target language, the relevant FAITH-SOURCE constraint is relativized to that particular source and ranked accordingly in the hierarchy. This was the case with the optional modification of syllables with of coda consonants in loans from Hausa compared to the obligatory modification of similar forms from Classical Arabic.

The implications of the proposed model of lexical stratification for learning were identified. It was suggested that the initial hierarchy should take cognizance of the fact that language learning involves more than one language at a time. There is thus a constraint stratum specific to items borrowed from other languages. When data from these other sources are received and they contradict established generalizations such constraints are ranked accordingly depending on whether adjustments are made or not.

Two constraint-based models of lexical stratification—core-periphery model and multiple faithfulness models—were reviewed, and their merits and drawbacks identified. Finally I examined a number of sundry issues pertinent to loan phonology putting them into the perspective of the approach to lexical stratification developed in this chapter.

## CHAPTER THREE

### HIATUS RESOLUTION

#### 1. Introduction

Hiatus, heterosyllabic vowel sequences, is prohibited in Nupe as in several other languages. This prohibition results in a number of hiatus resolution strategies. These strategies are universally available as a result of constraint interaction. Each hiatus resolution strategy requires reranking a set of conflicting constraints militating against each strategy resulting in a typology of hiatus resolution strategies. Since typology in OT is achieved by constraint reranking, any reranking of the conflicting constraints should instantiate a different grammar, and consequently a different language. When a language makes use of more than one hiatus resolution strategy—as many languages are wont to do—with each strategy requiring a different ranking of the same set of constraints, intralinguistic typological variation ensues. This requires an alternative approach to hiatus resolution in which language-internal variation can be adequately accounted for without recourse to reranking and the attendant ranking paradoxes. This approach consists in integrating universal tendencies with language-particular idiosyncrasies. The suggested approach is illustrated with hiatus resolution in Nupe which makes use of three strategies—glide formation (70a), assimilation (70b), and elision (70c).<sup>1</sup>

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<sup>1</sup>Smith (1967) describes the behavior of vowels in juxtaposition in Nupe and the effects can be characterized as glide formation, assimilation and elision. There are however terminological differences between Smith's description and the one that I will be developing here. I will indicate these differences where necessary. There will also be descriptonal differences and I will point these out accordingly.

Glide formation as used in the hiatus resolution literature makes the glide a part of the onset resulting in a complex onset. In Nupe as I demonstrate shortly the glide is part of the nucleus, and thus forms a rising diphthong with the following vowel (cf. Smith 1967). In this regard the strategy may be characterized as diphthong formation with the glide being a consequence of the nature of diphthongs. But to keep with standard practice I use the term glide formation to describe the pattern in (70a).

(70) *Hiatus resolution patterns*

- |    |         |                     |   |      |                   |
|----|---------|---------------------|---|------|-------------------|
| a. | egi     | a                   | → | egja | (i + a → ja)      |
|    | child   | 3rd Person Plural   |   |      | ‘their child’     |
| b. | ega     | u                   | → | eguu | (a + u → uu)      |
|    | visitor | 3rd Person Singular |   |      | ‘his visitor’     |
| c. | lá      | egi                 | → | lági | (a + e → a)       |
|    | carry   | child               |   |      | ‘carry the child’ |

I argue that the primary hiatus resolution strategy in Nupe is glide formation. Assimilation is a complement glide formation where the affected vowel lacks a corresponding glide. Elision on the other hand is a special strategy that affects the nominal prefix in Nupe. The approach developed here adequately accounts for the facts of hiatus resolution in Nupe and forms the basis of a typology of hiatus resolution strategies. The constraint ranking that accounts for glide formation as the primary strategy will need to be tinkered with to account for assimilation and elision. Such tinkering has the potential for ranking paradoxes. I appeal to a number of special constraints that encode the context of variation. Ranking these constraints appropriately resolves the potential ranking paradoxes engendered by intralinguistic typological variation arising from multiple hiatus resolution strategies in the same grammar.

Another instance of intralinguistic typological variation arises in the syllabic simplification of loanwords from different languages. This is examined in the second part of the chapter. It was demonstrated in chapter 2, section 4.2 that in loanwords from Classical Arabic codas are simplified by copying the vowel of the adjacent syllable to serve as nucleus for the coda consonant. The choice is attributed to the ranking of the

anti-epenthesis constraint above the constraint on multiple output correspondents (DEP » INTEGRITY). It is however the case that in certain contexts epenthesis is used instead of copying. This requires the ranking INTEGRITY » DEP, and hence intralinguistic typological variation. The former ranking is maintained and a number of special constraints are motivated and deployed accordingly to account for the variation and resolve the potential ranking paradox.

## 2. Hiatus

Vocalic hiatus is the occurrence of a sequence of vowels in different syllables. It has been pointed out that hiatus arises from morphological or syntactic concatenation (Casali 1996, 1997, Ola-Orie & Pulleyblank 2000, Pulleyblank 1998, and Rosenthal 1994, 1997). Hiatus may also occur word-internally. In such situations syllabification requires that each such vowel be associated to a syllabic nucleus. As with hiatus due to morphological and syntactic concatenation, this is resolved accordingly. Before the discussion of hiatus resolution strategies in Nupe it is important to give an insight into the vocalic inventory of the language, the distribution of vowels, and the hiatal configurations involving the vowels.

### 2.1 *Nupe vocalic inventory*

The inventory of Nupe vowel phonemes includes five oral vowels /i, e, a, o, u/ and three nasalized vowels /ĩ, ã, ũ/. Kawu (2000a) argues for recognizing the oral light diphthongs /ja, wa/ and the nasalized light diphthongs /jã, wã/ as part of the vocalic inventory of Nupe. More on the light diphthongs shortly. The examples of words with the vowels and diphthongs are given in (71).



(71) *Illustration of vocalic inventory*

## a. Oral vowels

egi	‘child’	ege	‘wine’
èfá	‘holiday’	èfo	‘hole’
èfú	‘honey’		

## b. Nasalized vowels

èkĩ	‘needle’	ekũ	‘corpse’
ekã	‘thorn’		

## c. Diphthongs

egjà	‘blood’	egwa	‘hand’
èfjã	‘two-pronged spear’	ekwã	‘millipede’

The distribution of the vowels and diphthongs in words is relatively restricted. Of the vowels and light diphthongs only /e/ and /a/ begin words in the language (cf. Smith 1967). There are however few native words that begin with /a/. Most other [a]-initial words are loanwords from either Classical Arabic or Hausa. Some native words beginning with [a] are given in (72). All vowels can however occur in the second syllable of vowel-initial words as in the examples in (71).

(72) *Native [a]-initial words*

aní	‘already’	àdiko	‘kind of bag’
árata	‘fifty’	àkpàrà	‘European rifle’
ádwáni	‘seventy’	àdàmagi	‘flint lock-gun’

Though the other vowels cannot begin words, some of them, as Smith points out, may occur as syntactically bound forms. All oral vowels except [i] and the light

diphthongs may occur as syntactically bound forms. Nasalized vowels never occur as syntactically bound forms. Examples of such forms are given in (73).

(73) *Syntactically bound forms*

è	Progressive
à	Future
a	3rd Person Plural
á	Perfective
o	Focus Marker
u	3rd Person Singular

The above notwithstanding, loanwords from Classical Arabic do begin with [i] and [u] as a result of their adaptation into Nupe. Examples of [i]- and [u]-initial loanwords are given in (74).

(74) *[i]- and [u]-initial Classical Arabic loanwords*

imani	‘faith’
ilimi	‘knowledge’
umura	‘minor pilgrimage’
ùsúma	‘feud’

I limit the discussion of hiatus resolution in the following sections to hiatal configurations involving native vocabulary items. I consider hiatal configurations involving the loanwords in (74) separately.

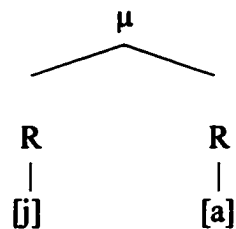
The foregoing gives an insight into possible hiatal configurations in Nupe to the effect that  $V_1$  can be any vowel or diphthong, oral or nasalized, while  $V_2$  is never a

diphthong or a nasalized vowel. But before considering the behavior of the vowels in hiatal configurations, a discussion of the diphthongs is necessary.

### 2.1.1 *Nupe diphthongs*

The forms with the diphthongs in (71d) have been of interest to Nupe phonologists and there is a difference of opinion with respect how they are to be analyzed. Smith (1967, 1969) regards [Cj] and [Cw] in these forms as consonant clusters. On this view, Smith concludes that other than these combinations (and those involving syllabic nasal followed by another consonant (cf. chapter 2, section 4)), there are no consonant clusters in Nupe. Hyman (1970a) on the other hand analyzes such sequences as palatalized [C<sup>j</sup>] and labialized [C<sup>w</sup>] consonants before [a]. The [a] is however /ɛ/ and /ɔ/ respectively in the underlying structure. In both cases it is absolutely neutralized to [a] on the surface after palatalizing or labializing the preceding consonant like the front /i, e/ and round /o, u/ vowels respectively. Hyman thus differs from Smith in regarding the sequences as secondarily articulated consonants rather than clusters. Hyman's analysis conforms with attested syllable structures of Nupe, structures that do not include consonant clusters. Madugu (n.d.) on the other hand, transcribing the glide-vowel sequences as [ʲa] and [ʷa], refers to them as diphthong-like vowels. In Kawu 2000a, an alternative to Hyman's abstract analysis, the sequences are however transcribed as [ja] and [wa]. Kawu refers to them as light diphthongs.

The characterization of the diphthongs as light is due to their monomoraicity. The glide and the vowel are linked to a single mora. In terms of root nodes, a root node dominates each segment, the root nodes are both linked to the mora as in (75).

(75) *Moraic structure of light diphthongs*

If the diphthongs were heavy the root nodes would be linked to different moras. A desirable piece of evidence for describing the diphthongs as light or as part of onset should come from quantity-sensitive phenomena. But the absence of such phenomena in the phonology of Nupe requires motivating other pieces of evidence. The characterization of the diphthongs as light rather than heavy conforms with the attested syllable types in Nupe to the effect that there are no phonologically heavy syllables in the language. Vowels and diphthongs are thus monomoraic. The difference is that while in vowels the mora dominates a single root node, it dominates two root nodes in diphthongs.

Another piece of evidence for the light diphthongs is that they correspond to the vowels /ɛ/ and /ɔ/ respectively in cognates from Yoruba, a related Benue-Congo language as in (76).

(76) *Nupe light diphthongs as correspondents of vowels in Yoruba cognates*

<u>Yoruba</u>	<u>Nupe</u>	
òfè	èfjá	‘gratis’
òdèdè	djàdjà	‘verandah’
kétékété	kjátjá	‘donkey’
rɔ	rwa	‘pour’
àrɔ	èrwa	‘funnel’

kpò	kpwà	‘be cheap’
ʃó	tswá	‘take care’
èkò	èkwa	‘pap’
òkò	èkwà	‘spear’
tòrè	twarja	‘give a gift’

The language cognate evidence is complemented by the adaptation of loanwords from English with [ɛ]- and [ɔ]-like vowels. Nupe replaces such vowels with the light diphthongs [ja] and [wa] respectively as in the examples in (77).

(77) *Diphthongs as replacements for [ɛ] and [ɔ] in loanwords from English*

<u>English</u>		<u>Nupe</u>	
brɛd	→	búrjádi	‘bread’
æləm	→	álwàmù	‘alum’

Despite the foregoing, vowels and diphthongs must still be distinguished with respect to their complexity. While vowels are simple segments, the diphthongs are complex. The simplicity of the vowels is a factor of their being single root nodes linked to a single mora, while the complexity of the diphthongs derives from two root nodes being linked to a single mora. More importantly, vowels have only one place specification, while diphthongs have two place specifications. The diphthong [ja] is [coronal, dorsal] and [wa] is [labial, dorsal]. In this regard either half of the diphthong may behave differently with respect to preceding or following segments. Thus [ja] palatalizes stridents while [wa] does not (cf. chapter 2, section 3). Furthermore

consonants are palatalized before [ja] while they are labialized before [wa] (cf. Kawu 2000a). This independent behavior of the constituent parts of the diphthongs is crucial for resolving hiatal configurations involving them.

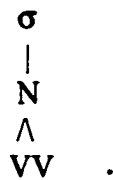
### **3. Hiatus Resolution**

The data in (70) indicate that vocalic hiatus contexts in Nupe arise from syntactic concatenation. But as pointed out earlier hiatus can occur word-internally. Instances of hiatus within the word, and those arising from morphological and syntactic concatenation arise from the syllabification of the vowels. While the syllabic affiliation of vowels in hiatus in instances of morphological and syntactic concatenation is determined prior to the concatenation, the same cannot be said of word-internal vowel sequences. It is however crucial for the analysis of hiatus to take into consideration the syllabic affiliation of the vowels involved. Since syllabification cannot be specified in the input, it must follow from the interaction of syllable structure constraints (cf. 41). The syllable structure constraint of particular relevance for the analysis of vocalic hiatus is \*COMPLEX. This bars associating more than one C or V to a syllable position. The constraint can be relativized to onset and nucleus. It is the one related to the nucleus that is crucial for the syllabic affiliation of input vowel sequences in the output. The constraint is as stated in (78).

#### **(78) \*COMPLEX-NUC**

No more than one V may associate to a syllable nucleus.

In view of the structure of the syllable in (40), (78) bars the configuration in (79).

(79) *Violation of \*COMPLEX-NUC*

The question that arises from the configuration is how V is characterized. V can be a short vowel, a long vowel, or a diphthong. On the analysis of each vocalic type as a single segment (cf. Kenstowicz 1994), the occurrence of either as a syllable nucleus does not constitute complexity. Kenstowicz (1994) further points out that the term “diphthong” is often used more broadly to denote any sequence of tautosyllabic vowels. The entire sequence may count as a single timing unit, that is, mora. But given that short vowels are distinguished from long vowels in terms of timing, long vowels may be represented as two moras. As for diphthongs, light diphthongs have a single timing unit, while heavy diphthongs have two timing units. Each segment by itself linked to the nucleus of the syllable does not therefore violate \*COMPLEX-NUC, but any combination of either results in a violation of the constraint.

In view of the foregoing, whether vowel sequences arise word-internally or from morphological and syntactic concatenation, associating each vowel to a different syllable in order to satisfy \*COMPLEX-NUC results in heterosyllabic vowel sequences. The resultant syllabification creates hiatus. That such sequences are not tolerated in languages is what necessitates hiatus resolution. There are two views in the literature with regard to what drives hiatus resolution. The first appeals to syllable well-formedness to the effect that the second vowel lacks an onset (Casali 1996, 1997, Rosenthal 1994, 1997). The second attributes hiatus resolution to articulatory difficulty resulting from

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resetting the articulators from one vowel to the following in a sequence of nonidentical vowels (Ola-Orie & Pulleyblank 2000, Pulleyblank 1998). The existence of several hiatus resolution strategies across languages suggests that providing the offending syllable with an onset does not suffice to resolve hiatus. In the same vein, making the vowels identical via assimilation does not suffice to resolve hiatus. Moreover hiatus is not restricted to a sequence of nonidentical vowels. In the following analysis any vowel sequence in separate syllables, be the vowels featurally identical or distinct, constitutes hiatus.

In addition, articulatory difficulty may not reside in resetting the articulators but from executing an articulatory break between vowel sequences. In effect such breaks are articulatorily easier between a vowel and a following consonant beginning another syllable than between vowels. For this reason the markedness constraint against heterosyllabic vowel sequences is formulated as in (80).

(80) NOHIATUS

Heterosyllabic vowel sequences are prohibited.

The formulation in (80) immediately suggests that hiatus may be resolved by articulating the vowels together resulting in tautosyllabification. The effect of tautosyllabification is that two vowels are linked to a single syllable nucleus in violation of the constraint against complex nuclei in (78). This is the case with a sequence of identical vowels in Nupe as in (81). Articulating the vowels separately and hence have them in separate syllables as in the parenthesized alternatives results in a violation of NOHIATUS.



(81) *Identical vowels in hiatus*

efè	è	tswǎ́	→	e.fèè.tswǎ́.	(*efè.è.tswǎ́.)
wind	Prog.	blow		‘the wind is blowing’	
ega	a		→	e.gaa.	(*e.ga.a)
visitor	3Pl.			‘their visitor’	
etsu	’u		→	e.tsuu.	(*e.tsu.u)
king	3S			‘his king’	
ègo	o		→	è.goo.	(*è.go.o)
worm	FM			‘it’s a worm’	

The data in (81) suggest that assigning the adjacent vowels to separate syllables as in the parenthesized forms creates hiatus, and hence a violation of NOHIATUS. These forms however satisfy \*COMPLEX-NUC as each syllable nucleus has only one vowel associated to it. That the forms with complex nuclei are better than those with heterosyllabified sequences suggests the ranking in (82).

(82) *Ranking for syllabification of identical vowel sequences*

NOHIATUS » \*COMPLEX-NUC

Besides the sequence of identical vowels arising from syntactic concatenation as in (81), there are word-internal sequences of identical vowels in Nupe. Words with such sequences are given in (83). They are syllabified as shown.

(83) *Word-internal identical vowel sequences*

kpáátá	→	kpáá.tá.	‘all’
gbáàní	→	gbáà.ní.	‘now’
déégi	→	déé.gi	‘few’/‘some’

lòóẏ	→	lòó.ẏ.	‘evening’
sùúsùúgi	→	sùú.sùú.gi.	‘waxbill’
baagi	→	baa.gi.	‘man’

As with the syntactic concatenation examples, syllabification of both vowels into a single syllable creates complex nuclei. The alternative of assigning each vowel to a separate syllable nucleus creates hiatus. The ranking in (82) favors tautosyllabification. Of course the question arises as to whether the ranking may not be relevant for the output. A way to make the ranking irrelevant is to analyze the sequences of identical vowels as long vowels. In this regard they are syllabified into a single nucleus. Since they are regarded as single segments, the option of heterosyllabification is not available, and hence no creation of hiatus. But since Nupe does not contrast short and long vowels, sequences of identical vowels are best regarded as short vowels with the possibility of each associating to a syllable nucleus. Despite the lack of contrastive long vowels, and as indicated in the preceding section, the absence of phonologically heavy syllables, such structures might emerge phonetically as in the above examples. This is not farfetched, as every theory of phonology recognizes allophony and noncontrastive phonological effects. Thus unattested structures may emerge in a language in response to universal tendencies or to improve structural markedness. The latter seems to be the case in Nupe as the creation of phonetically heavy syllables improves the marked structure engendered by hiatus.

The examples in (81) and (83) suggest that hiatus in Nupe may be avoided by tautosyllabification whether the vowel sequences are word-internal or arise from syntactic concatenation. The foregoing suggests that tautosyllabification suffices to resolve hiatus in Nupe. But as the data in (70) indicate there is more to hiatus resolution

in Nupe than tautosyllabification. In the next three sections I give an analysis of glide formation, assimilation, and elision as hiatus resolution strategies in Nupe.

#### 4. Glide Formation

Glide formation is the primary hiatus resolution strategy in Nupe. Vowels fall into two classes with respect to this. The front vowels /i, e/ turn to the palatal glide /j/ before a nonidentical vowel. The back round vowels /u, o/ turn to the labio-velar glide /w/ before a nonidentical vowel. The full range of effects of hiatus resolution in Nupe is better illustrated in the context of the boundary between lexical words and function words given the restrictions on the distribution of the vowels. The patterns for each possible combination are illustrated in (84) for front vowels, and (85) for back vowels.<sup>2</sup> In the outputs, the tone of the gliding vowel is realized on the second vowel. Identical tones

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<sup>2</sup> The facts of the behavior of vowels in juxtaposition as presented by Smith (1967) differ in some respects from the results presented here. The difference lies in the juxtaposition of what he refers to as typologically similar vowels. This groups together the front vowels /i/ and /e/ and the back vowels /u/ and /o/, and each possible combination results in a lengthened version of the second vowel. The effects are as follows:

- (i) /i/ + /e/ → [e:]
- (ii) /e/ + /e/ → [e:]
- (iii) /u/ + /o/ → [o:]
- (iv) /u/ + /u/ → [u:]
- (v) /o/ + /u/ → [u:]
- (vi) /o/ + /o/ → [o:]

Of particular interest are (i), (iii), and (v) where the first vowel becomes a corresponding glide in my description. Glide formation rather than assimilation is what occurs in my speech with these sequences. So once the juxtaposed vowels are nonidentical, the first turns into a corresponding glide as in (84) and (85). In addition, I represent sequences of identical vowels as tautosyllabified rather than as long vowels (cf. (81)). The long vowel notation suggests the elision of the first vowel followed by compensatory lengthening, while the sequential notation makes no such assumption.

For Smith only typologically different vowels result in glide formation (rising diphthongs with the second vowel). Hence any other vowel before [a] results in a diphthong as in (vii-x).

- (vii) /i/ + /a/ → [ja]
- (viii) /e/ + /a/ → [ja]
- (ix) /u/ + /a/ → [wa]
- (x) /o/ + /a/ → [wa]

fuse into one, while nonidentical tones result in contours on the second vowel. Smith (1967) represents the tonal contours as falling (ˆ) for both high-mid and mid-low contours, and rising (ˊ) for both low-high and low-mid contours. I adopt Smith's notation for ease of representation. In allowing contours involving mid tone, Nupe differs from a language like Yoruba (cf. Akinlabi 1985) that does not tolerate such contours. Also worthy of note is the preservation of the nasality of the gliding vowel on the second vowel.

(84) *Front vowels as  $V_1$  in hiatus with nonidentical  $V_2$*

a.	egi	è	tígí	→	e.gjê.	tígí
	child	Prog.	cry			'the child is crying'
	egi	o		→	e.gjo.	
	child	FM				'it's a child'
b.	efí	è	tso	→	e.fjê.	tso
	watch	Prog.	be fast			'the watch is fast'
	efí	o		→	e.fjô.	
	watch	FM				'it's a watch'
	efí	u		→	e.fjû.	
	watch	3S				'his watch'
	efí	a		→	e.fjâ.	
	watch	3Pl.				'their watch'
c.	ète	o		→	è.tjo.	
	gum	FM				'it's a gum'

ète	u	→	è.tju.
gum	3Pl.		‘his gum’
ète	a	→	è.tja.
gum	3Pl.		‘their gum’

(85) *Back vowels as  $V_1$  in hiatus with nonidentical  $V_2$*

a.	etsu	è	tígí	→	e.tswê.	tígí
	king	Prog.	cry			‘the king is crying’
	etsu	o		→	e.tswô.	
	king	FM				‘it’s the king’
	etsu	a		→	e.tswa.	
	king	3Pl.				‘their king’
b.	etũ	è	lo	→	e.twê.	lo
	work	Prog.	‘go’			‘work is going on’
	etũ	o		→	e.twõ.	
	work	FM				‘it’s work’
	etũ	a		→	e.twã.	
	work	3Pl.				‘their work’
c.	ègo	è	sò	→	è.gwê.	sò
	worm	Prog.	crawl			‘the worm is crawling’
	ègo	u		→	è.gwu.	
	worm	3S				‘his worm’

ègo                      a                      →                      è.gwa.  
 worm                      3Pl.                      ‘their worm’

The table in (86) gives the input-output mappings of the different vowel combinations that result in glide formation.

(86) *Patterns of glide formation*

	e	a	o	u
i	je	ja	jo	ju
e		ja	jo	ju
o	we	wa		wu
u	we	wa	wo	

One effect of glide formation as hiatus resolution strategy is that every segment in the input has a correspondent in the output. It follows that the constraint in (87) is high ranking.

(87) MAX-IO

Every input segment has a correspondent in the output.

Another effect of glide formation is that input vowels are tautosyllabified. Though the vowels belong to separate morphemes and should have different syllabic affiliations prior to syntactic concatenation, the parallel nature of OT does not allow for such a computation. The option of heterosyllabification creates hiatus. As in the case of sequences of identical vowels, assigning both vowels to a single syllable nucleus avoids hiatus but results in a complex nucleus. Hence, for instance, the mapping  $i + a \rightarrow ia$  suffices to satisfy NO-HIATUS.

Since the mapping  $i + a \rightarrow ia$  suffices to resolve hiatus, the question arises as to why the first vowel turns into a glide. The vowel turns into a glide in order to avoid two Vs linked to the syllabic nucleus, and thus satisfies \*COMPLEX-NUC. In the case of a sequence of identical vowels, the two Vs associated to the syllable nucleus are not

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featurally distinct. But in the case of nonidentical sequences, the two Vs are featurally distinct. This suggests that only identical vowels can be associated to a syllable nucleus. There is thus a sense in which vowels with identical features linked to the syllable nucleus is less marked than vowels with distinct features. It is this that drives glide formation leaving just one set of vocalic features linked to the syllable nucleus. This necessitates revising the constraint against complex nuclei to the effect that Vs associated to the syllable nucleus must not be featurally distinct. The revised constraint is as in (88).

(88) \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>]

No more than one V with distinct features may associate to a syllable nucleus.

In view of the foregoing, assimilation should be a possible option for resolving hiatus in sequences of nonidentical vowels. Hence, for instance, the mapping  $i + a \rightarrow aa/ii$  should be optimal. But since this is not the case assimilation needs to be blocked in these instances. A constraint to this effect should be one that requires featural identity between input and output vowels. An IDENT constraint should suffice but it does not since the output glide is not identical to its corresponding input vowel. I return to this issue shortly. The relevant constraint can be formulated in terms of anchoring. McCarthy and Prince (1995) define ANCHOR as in (89).

(89) {RIGHT, LEFT}-ANCHOR(S<sub>1</sub>, S<sub>2</sub>)

Any element at the designated periphery of S<sub>1</sub> has a correspondent at the designated periphery of S<sub>2</sub>.

Let  $Edge(X, \{L, R\})$  = the element standing at the Edge = L,R of X.

RIGHT-ANCHOR. If  $x = Edge(S_1, R)$  and  $y = Edge(S_2, R)$  then  $x \Re y$ .

LEFT-ANCHOR. Likewise, *mutadis mutandis*.

The definition in (89) can be relativized to any phonological element, in particular segments and features. For this reason I formulate a feature version to the effect that no feature of input segments may be realized on another segment in the output in (90).

(90) ANCHOR-FEATURE-IO

No feature of an input segment may be anchored to another segment in the output. Though (90) bars assimilation, its domination by other constraints may compel the realization of features of input segments on other segments in the output. This is the case with nasality and tone in the glide formation data in (84-85).

The third effect of glide formation is that input vowels have glides as output correspondents. There is thus a difference in identity between the vowels and the corresponding glides. The pertinent issue is the feature that distinguishes vowels from glides. Despite the observed articulatory similarities between high vowels [i] and [u] and the corresponding glides [j] and [w] there is need to distinguish them featurally. Vowels and glides have been distinguished in generative phonology by means of features (Chomsky & Halle 1968, Steriade 1984, among others), syllabic location (Clements & Keyser 1983, Kaye & Lowenstamm 1984, Levin 1985), and moraic association (Hyman 1985, McCarthy & Prince 1986, Hayes 1989). The view of vowels occurring as syllable peaks and glides occurring at syllable margins as in the syllabic location approach does not provide sufficient insight into how each class of sounds should be featurally characterized. The same is true of the moraic association approach to the effect that glides are linked directly to the syllable node while vowels are linked to the mora. The feature [+syllabic] thus lacks any phonetic correlate. Though vowels and glides are considered [-consonantal], Hyman (1985) claims that this is only in the underlying



structure. The underlying feature specification notwithstanding, Hyman concludes that glides are [+consonantal] on the surface, while vowels are [-consonantal]. It should however be possible to uniformly distinguish glides from vowels at both levels of representation. Another feature used to characterize vowels and glides is [approximant] (Clements 1990). Clements uses the feature to group together glides and liquids to distinguish them from other sonorants. But vowels and glides are regarded as [+approximant]. The only feature that distinguishes glides from vowels without regard to syllabic function, moraic association, or level of representation is *SPE*'s [vocalic]. In this regard vowels are [+vocalic] while glides are [-vocalic]. It is in terms of this feature that the vowels and corresponding glides in Nupe differ, and the identity constraint is as in (91).

(91) IDENT-IO(vocalic)

Corresponding input-output segments are identical in the feature [vocalic].

Finally the issue arises as to the interpretation of the resulting glide with respect to the preceding consonant and the following vowel. The first interpretation is to regard the glide as part of the onset. It thus forms a complex consonant-glide onset. The phonotactics of the language does not however support this interpretation, but nothing in principle rules it out. The crucial thing is the difference in identity between the input vowel and the corresponding glide output. The second interpretation is to regard the glide as part of the nucleus forming a glide-vowel diphthong with the following vowel. This interpretation finds support in the presence of light diphthongs in the language. Light diphthongs form syllable nuclei as in the examples in (71c). This interpretation also

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accords with Smith's (1967) description of the resulting forms as rising diphthongs with the glides [j] or [w] as the first element and the following vowel as the second element.

The constraints motivated in the foregoing discussion are ranked accordingly to account for glide formation as the primary hiatus resolution strategy in Nupe. The ranking is as in (92). The ranking is illustrated with a tableau in (93).

(92) *Ranking for glide formation as hiatus resolution strategy*

NOHIATUS, MAX-IO, ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(vocalic)

(93) *Tableau for glide formation as optimal analysis of hiatus resolution*

Input: egi + a	NOHIATUS	MAX-IO	ANCHOR-FEATURE-IO	*COMPLEX-NUC[V <sub>i</sub> V <sub>j</sub> ]	IDENT-IO(vocalic)
a. e.gi.a	*!				
b. e.gi.		*!			
c. e.ga.		*!			
d. e.gaa.			*!		
e. e.gii.			*!		
f. e.gia.				*!	
g. e.gja.					*

In (93), candidate (a) with the input vowels parsed heterosyllabically fatally violates NOHIATUS. It satisfies all other constraints. Candidates (b) and (c) avoid violations of NOHIATUS by deleting V<sub>2</sub> and V<sub>1</sub> respectively. But in each case there is an input segment that lacks a correspondent in the output, a fatal violation of MAX-IO. Candidates (d) and (e) with V<sub>1</sub> assimilating to V<sub>2</sub> and vice versa satisfy NOHIATUS as well as MAX-IO. Each however incurs a fatal violation of ANCHOR-FEATURE-IO as there are features of an input segment realized on another segment in the output. The assimilation candidates do satisfy \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>]. Candidate (f), which like candidates (d) and (e), has the input vowels tautosyllabified, avoids a violation of ANCHOR-FEATURE-IO. But the failure of the high vowel to turn into a glide leads to two featurally distinct Vs linked to the syllable

nucleus. This incurs a fatal violation of \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>]. The optimal candidate (g) avoids a violation of \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] since the first vowel turning into a glide leaves only one V linked to the syllable nucleus. But this results in a difference in identity between the input vowel and its output glide correspondent.

The crucial rankings in the constraint hierarchy as evident from the tableau are ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] and \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(vocalic). The first ensures that assimilation does not take place to avoid two Vs with distinct features linked to the syllable nucleus. The second ensures that a complex nucleus is avoided by having one V linked to the syllable nucleus. But this results in a difference in identity between the input vowel and its corresponding output. It is this ranking that forces glide formation. That all suboptimal candidates satisfy IDENT-IO(vocalic) which the optimal candidate violates justifies its low ranking in the hierarchy. Tautosyllabification of distinct vowels results in high or mid V<sub>1</sub> turning into a corresponding glide in order to avoid a complex nucleus. There are however instances with similar vowels where tautosyllabification does not result in glide formation.

#### 4.1 *Tautosyllabification without glide formation*

In hiatal configurations with the onset of the syllable containing V<sub>1</sub> itself a glide and V<sub>1</sub> being a high or mid vowel, hiatus is resolved by tautosyllabification without the high vowel turning into a corresponding glide. While the palatal glide /j/ combines with the high front vowels /i, ĩ, e/ it does not combine with the high back vowels /u, ũ, o/. The labio-velar glide /w/ on the other hand combines with the high back vowels /u, ũ, o/ but does not combine productively with the front high vowels /i, ĩ, e/. Smith (1967) notes that there are only two words *wê* ‘you’ and *wî* ‘him’ with the labio-velar-front vowel

combination. Hiatal configurations involving glide-vowel syllables before a nonidentical vowel and their resolution without  $V_1$  turning into a corresponding glide are given in (94).

(94) *Resolution of hiatus without glide formation*

ji	a	→	jia.	(*jja)
call	3Pl.		‘call them’	
ji	u	→	jiu.	(*jju)
call	3S		‘call him’	
eji	o	→	e.jio.	(*e.jjo.)
corn	FM		‘it’s corn’	
je	a	→	jea.	(*jja)
shift	3Pl.		‘shift them’	
je	u	→	jeu.	(*jju)
shift	3S		‘shift it’	
ejé	o	→	e.jéo.	(*e.jjo.)
eyes	FM		‘it’s eyes’	
wu	a	→	wua.	(*wwa)
beat	3Pl.		‘beat them’	
ewó	a	→	e.wóa.	(*e.wwa.)
money	3Pl.		‘their money’	

The data in (93) bear out the predictions of the preceding analysis to the effect that hiatus is resolved via tautosyllabification and that each input has an output correspondent. The question arises as to whether the vowels are indeed tautosyllabified. The evidence for tautosyllabification comes from nasalization. Recall the discussion from

chapter two, section four to the effect that tautosyllabic sequences of sonorants agree in nasality. In examples like (94) where  $V_1$  is a nasalized vowel, the oral  $V_2$  is nasalized in the output. The fact that it is nasalized is indication that it is in the same syllable with the nasalized vowel. Examples are given in (95).

(95) *Nasal agreement between tautosyllabified vowels*

jĩ	a	jĩã.
swallow	3S	‘swallow them’
eĩ	u	e.jĩũ.
hair	3S	‘his hair’
eĩ	o	e.jĩõ.
hair	FM	‘it’s hair’
wũ	a	wũã.
own	3Pl	‘own them’
ewũ	o	e.wũõ.
quarrel	FM	‘it’s a quarrel’

In view of the foregoing,  $V_1$  and  $V_2$  are tautosyllabified in the examples in (94) and (95). But unlike in the glide formation data,  $V_1$  does not turn into a corresponding glide as predicted. The analysis predicts that the parenthesized outputs in (94) should be optimal. These outputs are suboptimal as they have glide-glide sequences, sequences that rarely occur in languages (cf. Kaisse 1992). The rarity of such sequences may be attributed to the OCP. But if the glide is the first element of the rising diphthong on the view that it is part of the nucleus, then the failure of glide formation may be a factor of

sonority sequencing. This is to the effect that sonority should rise towards the nucleus. But given that the glides are of equal sonority, turning the vowel into a glide negates sonority sequencing. An informal formulation of a constraint that captures sonority sequencing is as in (96).

(96) SONSEQ

Sonority must rise towards the nucleus.

For hiatus to be resolved by tautosyllabification without glide formation results in complex nuclei. For this reason the ranking SONSEQ » COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] must hold. This ranking is illustrated with the tableau in (97). Only the constraint interaction that accounts for failure of glide formation is shown.

(97) *Tableau for resolution of hiatus without glide formation*

Input:	ji + a	NOHIATUS : SONSEQ	COMPLEX-NUC[V <sub>i</sub> V <sub>j</sub> ]	IDENT-IO(voc)
a.	ji.a.	*!		
b.	jja		*!	*
c.	jia.		*	

The facts that emerge from the analysis of glide formation as the primary hiatus resolution strategy in Nupe are as follows. Hiatus is resolved by tautosyllabifying vowel sequences. High and mid vowels turn to corresponding glides before nonidentical vowels. All inputs have output correspondents. The outputs are featurally different from their input correspondents. These facts are crucial to the analysis of assimilation as a complement of glide formation in hiatal configurations.

## 5. Assimilation

The low vowel /a/ as V<sub>1</sub> in hiatal configurations in Nupe behaves differently from high and mid vowels. Unlike high and mid vowels that turn to corresponding glides in the

same configuration, /a/ assimilates to the following qualitatively distinct vowel as in the examples in (98).

(98) *Low vowel as  $V_1$  in hiatus*

ega	è	tígí	→	e.geè. tígí
visitor	Prog.	cry		‘the visitor is crying’
ega	o		→	e.goo.
visitor	FM			‘it’s the visitor’
ega	u		→	e.guu.
visitor	3S			‘his visitor’
egà	è	lo	→	e.gèè. lo
talk	Prog.	go		‘talk is going on’
egà	o		→	e.gòò.
talk	FM			‘it’s talk’

When the light diphthongs /ja/ and /wa/ occur as  $V_1$  in hiatal configurations the vowel half /a/ assimilates to the following vowel as in (99).

(99) *Light diphthongs as  $V_1$  in hiatus*

egjà	è	tśí	→	e.gjèè. tśí
blood	Prog.	descend		‘blood is dripping’
egjà	o		→	e.gjòo.
blood	FM			‘it’s blood’
egjà	u		→	e.gjùu.
blood	3S			‘his blood’

èfjá		o	→	e.fjóõ.
two-pronged spear	3S			'it's a two-pronged spear'
èfjá		u	→	e.fjúũ.
two-pronged spear	3S			'his two-pronged spear'
egwa	è	du	→	e.gwèè. du
hand	Prog.	shake		'the hand is shaking'
egwa		o	→	e.gwoo.
hand	FM			'it's a hand'
egwa		u	→	e.gwuu.
hand	3S			'his hand'
ètswǎ		o	→	è.tswóõ.
stench	3S			'it's stench'
ètswǎ		u	→	è.tswũũ.
stench	3S			'its stench'

The table in (100) shows the assimilation pattern involving low vowels and light diphthongs.

(100) *Patterns of assimilation*

	e	u	o
a	ee	uu	oo
ja	jee	juu	joo
wa	wee	wuu	woo

For the sake of completeness, forms with either glide as onset and the low vowel as nucleus before other vowels have the low vowel assimilating the features of the following vowel as in the patterns in (100). Examples are given in (101).



(101) *Hiatus involving [ja] and [wa] occurring as independent items*

eja	è	sò	→	e.jeè. sò
canoe	Prog.	crawl		‘the canoe is crawling’
ja		u	→	juu.
release		3S		‘release it’
eja		o	→	e.joo.
canoe		FM		‘it’s a canoe’
ewa	è	sò	→	e.weè. sò
snake	Prog.	crawl		‘the snake is crawling’
wa		u	→	wuu
remove		3S		‘remove it’
ewa		o	→	e.woo.
snake		FM		‘it’s a snake’

The data in (99) raise the issue of assimilation affecting one half of the diphthong and not the other. Since assimilation targets the root node each segment linked to the mora may affect or be affected by a preceding or following segment as the case may be. This is why the glide half, independent of the vowel half, palatalizes or labializes preceding segments accordingly. In the same way the following segment may independently affect the vowel half. On this view the resulting syllable in (98) and (99) can be interpreted phonetically as heavy, that is, bimoraic. In the former the assimilated vowel and the assimilating vowel are linked to different moras, while in the latter the diphthong with its assimilated vowel half is linked to a mora and the assimilating vowel is linked to another mora.

The examples in (98, 99, 101) show that as in glide formation, hiatus is resolved by tautosyllabifying the input vowels, every input segment has a correspondent in the output, and the output of one of the input vowels is not identical to its corresponding input. In this respect assimilation is considered as a complement of glide formation, and the difference between the two is what needs to be accounted for. The difference is that in glide formation complex nuclei are avoided, that is, there is only one V associated to the syllable nucleus. Assimilation on the other hand creates complex nuclei. But the complex nuclei consist of vowels with identical features.

In the discussion of glide formation I argued that one of the crucial rankings is  $*\text{COMPLEX-NUC}[V_i V_j] \gg \text{IDENT-IO}(\text{vocalic})$ . This ranking forces glide formation in tautosyllabified sequences involving high and mid vowels. In order to permit assimilation, the ranking can no longer be crucial as assimilation satisfies both constraints. Corresponding segments are identical for the feature [vocalic], and the resulting complex nucleus has vowels with identical features. Undoing the established domination relation has the potential for creating a paradox. The potential paradox has to be preempted.

The other crucial ranking in the hierarchy motivated for glide formation is  $\text{ANCHOR-FEATURE-IO} \gg * \text{COMPLEX-NUC}[V_i V_j]$ . This ranking prevents assimilation of the vowels in hiatus in order to have a complex nucleus of identical vowels. For assimilation to be optimal the ranking has to be reversed such that  $* \text{COMPLEX-NUC}[V_i V_j] \gg \text{ANCHOR-FEATURE-IO}$ . Allowing both rankings to co-exist in the grammar introduces a ranking paradox. The paradox engendered by undoing the domination relation between  $* \text{COMPLEX-NUC}[V_i V_j]$  and  $\text{IDENT-IO}(\text{vocalic})$  and that engendered by reversing that

between ANCHOR-FEATURE-IO and \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] can be preempted by motivating a special constraint. Ranking the special constraint accordingly allows for keeping the crucial rankings motivated for glide formation as hiatus resolution strategy.

Maintaining the rankings \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(vocalic) and ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] is crucially dependent on there being a corresponding glide to the low vowel in Nupe. But low glides are rare cross-linguistically. Assuming that there is a general markedness constraint against glides, then the one against low glides will be a special version of this general markedness constraint. The constraint is formulated in (102).<sup>3</sup>

(102) \*LOW-GLIDE

Low glides are impossible.

Deploying (100) into the hierarchy motivated for glide formation as in \*LOW-GLIDE » ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(vocalic) resolves the potential paradox. But it does not account for all the effects of assimilation. One such effect is the direction of assimilation. The preference for regressive assimilation over progressive assimilation can be attributed to one of two factors. The first is that the V<sub>2</sub>s in

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<sup>3</sup> Casali (1996) proposes constraints on glides that include (102). The constraints are to the effect that a glide must not be low, and that a glide must be front or round. This is to capture the fact that low vowels do not become glides, but that high and mid vowels may become glides. Languages differ with respect to the behavior of mid vowels. Some languages glide them as in Nupe, while some others do not. Languages that primarily use glide formation as hiatus resolution strategy will differ with respect to the treatment of mid and low vowels. Casali however claims that in such languages vowel elision takes place when V<sub>1</sub> is /a/. This need not be the case as the Nupe data show.

Rosenthal (1994, 1997) on the other hand attributes the rarity of low glides to a constraint that requires the particle {A} in particle-based theories of phonology to be associated only to nuclear positions. Following McCarthy and Prince (1993a) the constraint is formulated to the effect that the low vowel must be linked to a mora ({A} = V). Since it is necessary to leave open the possibility of languages with low vowel-glide alternation all that needs to be said is that in Nupe and other languages without this alternation (102) is not crucially dominated.

the glide formation and assimilation data are the only segments of their morphemes. Changing the identity of the segments obscures the meaning of the morphemes. The second is the general tendency to be faithful to segments in morpheme initial position à la positional faithfulness (Beckman 1995, cf. Casali 1997 for its relevance for elision as hiatus resolution strategy). Given the fact that  $V_1$  is the affected vowel in both glide formation and assimilation suggests that  $V_2$  is protected from undergoing identity changes by virtue of its being morpheme initial. The relevant identity constraint is formulated in (103).

(103) IDENTMI-IO

Every morpheme initial segment in the input is identical to its correspondent in the output.

As with glide formation, assimilation results in changes in identity between inputs and their output correspondents. The relevant IDENT constraint is given in (104).

(104) IDENT-IO(low)

Corresponding input-output segments are identical for the feature [low].

The constraint interaction that is required to account for assimilation as choice of hiatus resolution strategy when  $V_1$  is the low vowel [a] is as in (105). The ranking is illustrated in the tableau in (106).

(105) *Ranking for assimilation as hiatus resolution strategy*

NOHIATUS, MAX-IO, IDENTMI-IO, \*LOW-GLIDE » ANCHOR-FEATURE-IO »  
\*COMPLEX-NUC[ $V_i V_j$ ] » IDENT-IO(low)

(106) *Tableau for assimilation as optimal analysis of hiatus resolution*

Input: ega + o	NO HIATUS	MAX- IO	IDENT MI-IO	*LOW- GLIDE	ANC- FEAT-IO	*COMP- NUC[V <sub>i</sub> V <sub>j</sub> ]	IDENT- IO(low)
a. e.ga.o	*!						
b. e.ga.		*!					
c. e.go.		*!					
d. e.gao.						*!	
e. e.gAo.				*!			
f. e.gaa.			*!		*		
g. e.goo.					*		*

In (106), the candidate with heterosyllabic vowel sequences (a) incurs a fatal violation of the constraint against hiatus while satisfying all others. The deletion candidates (b) and (c) are suboptimal as they fatally violate MAX-IO. Candidate (d) incurs a fatal violation of \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] as the two vowels associated to the syllable nucleus have distinct features. This violation is avoided by candidate (e) with the low vowel turning into a glide (the notation “A” is due to Casali (1996)), but it fatally violates the constraint against low glides. Candidate (f) with V<sub>2</sub> assimilating the features of the low V<sub>1</sub> (progressive assimilation) avoids a violation of \*LOW-GLIDE. But since the identity of the morpheme initial segment is obscured, it incurs a fatal violation of IDENTMI-IO. The optimal candidate (g) with the low V<sub>1</sub> assimilating the features of the morpheme initial V<sub>2</sub> (regressive assimilation) avoids a violation of IDENTMI-IO. Since it satisfies all high ranking constraints, and violates only the low ranking ones, most especially IDENT-IO(low), it is considered optimal. The difference between candidate (f) and (g) is that some identity violation (IDENTMI-IO) is fatal for the one while another identity violation (IDENT-IO(low)) is nonfatal for the other. Both however violate the anti-assimilation constraint ANCHOR-FEATURE-IO, a violation that is not fatal for either of them.

A comparison of (93) and (106) shows that both glide formation and assimilation have similar constraint satisfaction-violation profiles. The optimal candidates in both cases satisfy higher-ranked constraints while violating the lower-ranked ones. Crucially, glide formation and assimilation result in a difference in identity between some input and its output correspondent. In the case of the former the input and output differ in the feature [vocalic] while in the case of the latter the input and output differ in the feature [low]. This establishes the fact that assimilation is a complement of glide formation, and that it is the result of the lack of a corresponding glide to the affected vowel.

The foregoing analysis of glide formation and assimilation as hiatus resolution strategies in Nupe involved native vocabulary items in which  $V_1$  is unrestricted while  $V_2$  is restricted to syntactically bound forms that are monosegmental. I indicated earlier that loanwords from Classical Arabic do begin with [i] and [u]. The other vowel that begins such loanwords is [a]. In hiatal configurations involving [a]-, [i]-, [u]-initial words the vowels are heterosyllabified. Neither glide formation nor assimilation takes place. Such heterosyllabification results in hiatus. This is not resolved in any way. Note that such vowel-initial words are adapted since output onsetless syllables are not attested in Arabic. Nupe modifies forms with initial glottal stop (ʔ) or pharyngeal fricative (ʕ) or any other segment with no Nupe approximate by deletion since they are not attested in Nupe. This results in such forms being vowel initial in Nupe. Examples of hiatus involving such words are given in (107).

(107) *Multisegmental [a]-, [i], and [u]-initial loanwords in hiatus*

- |    |        |          |   |                   |
|----|--------|----------|---|-------------------|
| a. | li     | àdini    | → | li.a.dì.ni.       |
|    | choose | religion |   | ‘choose religion’ |

	de	àdíni	→	de.a.dí.ni.
	have	religion		‘have religion’
	lámitú	àdíni	→	lá.mi.tú.a.dí.ni
	follow	religion		‘follow religion’
	lò	àdíni	→	lò.à.dí.ni.
	use	religion		‘use religion’
	wá	àdíni	→	wá.à.dí.ni.
	seek	religion		‘seek religion’
b.	li	imani	→	li.i.ma.ni.
	choose	faith		‘choose faith’
	de	imani	→	de.i.ma.ni.
	have	faith		‘have faith’
	wú	imani	→	wú.i.ma.ni.
	show	faith		‘show faith’
	lò	imani	→	lò.i.ma.ni.
	use	faith		‘use faith’
	wá	imani	→	wá.i.ma.ni
	seek	faith		‘seek faith’
	li	ílimi	→	li.í.lì.mi
	choose	knowledge		‘choose knowledge’
	de	ílimi	→	de.í.lì.mi
	have	knowledge		‘have knowledge’

	wú	ílimi	→	wú.í.limi
	show	knowledge		‘show knowledge’
	lò	ílimi	→	lò.í.limi
	use	knowledge		‘use knowledge’
	wá	ílimi	→	wá.í.li.mi.
	seek	knowledge		‘seek knowledge’
c.	wú	umura	→	wú.u.mu.ra.
	show	minor pilgrimage		‘show minor pilgrimage’
	li	umura	→	li.u.mu.ra.
	choose	minor pilgrimage		‘choose minor pilgrimage’
	bé	umura	→	bé.u.mu.ra.
	come	minor pilgrimage		‘come to minor pilgrimage’
	lo	umura	→	lo.u.mu.ra.
	go	minor pilgrimage		‘go to minor pilgrimage’
	ka	umura	→	ka.u.mu.ra.
	wait	minor pilgrimage		‘wait for minor pilgrimage’

Heterosyllabification is not restricted to multisegmental loanwords in hiatus.

There are native [a]-initial words. When such words occur in hiatal configurations, hiatus is not resolved. Examples are given in (108).

(108) *Multisegmental [a]-initial native word in hiatus*

egi	árata	e.gi.á.ra.ta.
child	fifty	‘fifty children’



ète	árata	è.te.á.ra.ta.
gum	fifty	'fifty gums'
ega	árata	e.ga.á.ra.ta.
visitor	fifty	'fifty visitors'
etsu	árata	e.tsu.á.ra.ta.
king	fifty	'fifty kings'
ègo	árata	è.go.á.ra.ta.
worm	fifty	'fifty worms'

The difference between the data in (107-108) and the data for glide formation and assimilation is that the  $V_2$ s in the glide formation and assimilation data are monosegmental, and hence syntactically bound forms while the  $V_2$ s in the above examples are part of multisegmental, and hence prosodic words. This suggests that syntactically bound forms can be tautosyllabified, while prosodic words may not be tautosyllabified. In this regard prosodic words prefer to be aligned with the edge of the syllable. This preference blocks tautosyllabification and leads to hiatus being tolerated. The relevant constraint is stated in (109).

(109) ALIGN(PrWd, L,  $\sigma$ , L)

Align the left edge of the prosodic word with the left edge of the syllable.

The ranking that is required to account for the optimality of heterosyllabic vowel sequences as in the above examples is ALIGN(PrWd, L,  $\sigma$ , L) » NOHIATUS. This ranking is illustrated in the tableau in (110).

(110) *Tableau for heterosyllabification of prosodic words in hiatus*

Input: egi + árata	ALIGN(PrWd, L, $\sigma$ , L)	NOHIATUS
a. e.gjá.rata	*!	*
b. egi.á.ra.ta.		

The analyses of glide formation and assimilation as hiatus resolution strategies in Nupe show that every input in a hiatal configuration has a correspondent in the output, suggesting that elision is not an option. But in some hiatal configurations elision is used as a resolution strategy.

## 6. Elision

The examples of hiatus discussed in the preceding sections, besides those involving loanwords and [a]-initial native words, have syntactically bound forms as  $V_2$ . In hiatal configurations where  $V_2$  is the first vowel of a noun of the form  $e$ -CV, it is deleted, the quality of  $V_1$  notwithstanding. Thus unlike in glide formation and assimilation where  $V_1$  is the affected vowel, elision affects  $V_2$ .<sup>4</sup> The hiatal configuration in which elision takes place is the boundary between two lexical words, a verb followed by a noun as in (111a), and a noun followed by another noun as in the associative construction (111b). The associative marker is a floating high tone. It docks on  $V_1$ , and thus fuses with it or forms a contour tone with the tone of  $V_1$ .

### (111) *Elision of prefixal $V_2$ in hiatus*

a.	li	ezà	→	li.zà
	choose	person		‘choose a person’

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<sup>4</sup> Casali (1996, 1997) lists Nupe as one of the languages that consistently elide  $V_1$  at the boundary between two lexical words. The data in (111) clearly show that this is not the case. He further notes that Nupe elides  $V_2$  at the boundary between a root and a suffix. Vowel initial suffixes are however not attested in Nupe. Other than in these contexts elision is not the primary hiatus resolution strategy in Nupe. Casali cites Smith (1967, 1969) for his claims about hiatus resolution in Nupe. The impression of  $V_1$  elision may be due to Smith's notation with respect to the juxtaposition of typologically similar vowels to the effect that the output is a lengthened version of the second vowel (cf. fn.2). As for the claim about suffixes, Smith does

	de		ega	→	de.ga
	have		visitor		‘have a visitor’
	lù		eni	→	lù.ni
	cook		stew		‘cook stew’
	ló		èga	→	ló.ga
	enter		barn		‘enter a barn’
	lá		egi	→	lá.gi
	carry		child		‘carry a child’
	tʃjà		èdzó	→	tʃjà.dzó
	start		play		‘start play’
	tswá		egi	→	tswá.gi
	take care		child		‘take care of child’
b.	etí		egi	→	e.tí.gi
	head	Ass.	child		‘child’s head’
	ète		egi	→	è.tě.gi
	gum	Ass.	child		‘child’s gum’
	èga		egi	→	è.gǎ.gi
	barn	Ass.	child		‘child’s barn’
	èwò	”	egi	→	è.wǒ.gi
	shirt	Ass.	child		‘child’s shirt’

---

not provide a one-to-one gloss of the data and Casali may have interpreted the singly occurring vowels that

èfú	'	egi	→	è.fú.gi
honey	Ass.	child		'child's honey'
egjà	'	egi	→	e.gjǎ.gi
blood	Ass.	child		'child's blood'
egwa	'	egi	→	e.gwǎ.gi
hand	Ass.	child		'child's hand'

Elision differs from glide formation and assimilation in that not every input has a correspondent in the output. Another difference is that while the tone of the glided vowel in glide formation is realized on the surviving vowel, the tone of the elided vowel is deleted along with it. The hierarchy motivated for glide formation and assimilation has MAX-IO high ranking. In order to account for elision MAX-IO would have to be ranked lowest in the hierarchy. This reranking if allowed will lead to a ranking paradox. The potential paradox is avoided if a special constraint is motivated and ranked accordingly. The special constraint derives from the nature of  $V_2$  in the above examples.

The initial vowel of nouns of the form  $e$ -CV is a nominal prefix (cf. George 1970, Smith 1967). Its deletion, in contrast to the retention of other vowels in the same position in the glide formation and assimilation data, is attributed to the fact that it is a prefix while the others are root vowels. The preference for faithfulness to root segments over affixal segments is a factor of the Root Affix Faithfulness Metaconstraint (RAFM) (McCarthy & Prince 1995) given in (112).

(112) *Root Affix Faithfulness Metaconstraint*

ROOT-FAITH » AFFIX-FAITH

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I have shown to be function words as suffixes.

In view of RAFM the general MAX-IO constraint featured in the rankings (92) and (105) can be split into its special in respect of roots and affixes as in (113).

(113) *Special MAX-IO constraints*

a. MAX-IO-ROOT

Every segment in the root has a correspondent in the output.

b. MAX-IO-AFFIX

Every segment in the affix has a correspondent in the output.

In the rankings motivated thus far (113a) takes the place of the general constraint while (113b) is ranked lowest in the hierarchy. In this regard the potential paradox that would arise from moving MAX-IO to the bottom of the hierarchy is avoided.

Before demonstrating the constraint interaction that accounts for elision as a special hiatus resolution strategy, it is appropriate to give some evidence for the analysis of /e/ as a nominal prefix in nouns of the form *e*-CV. The first piece of evidence is that nouns are formed from verbs by *è*-prefixation as in (114). The prefix has a low tone. In synchronically underived nouns as in some of the examples in (111) the nominal prefix can either have a mid or low tone, but never a high tone.

(114) *Noun formation from verbs by 'è'-prefixation*

<u>Verb</u>		<u>Noun</u>
fā	→	èfā
'rest'		'holiday'
rwa	→	èrwa
'pour'		'funnel'

bo	→	èbo
'be tired'		'tiredness'
sà	→	èsà
'be pretty'		'beauty'

When the derived nouns occur in hiatal configurations, the prefix, as well as its tone, is regularly elided as in (115).

(115) *Elision of 'è'-prefix in hiatus*

gí	.	èfá	→	gí.fá
eat		holiday		'spend holiday'
de		èrwa	→	de.rwa
have		funnel		'have a funnel'
wá		èrwa	→	wá.rwa
want		funnel		'want a funnel'
wo		èbo	→	wo.bo
feel		tiredness		'feel tired'
wú		èsà	→	wú.sà
show		beauty		'show beauty'

The second piece of evidence for the analysis of *e* as a nominal prefix, and hence susceptible to elision, is that in some common nouns *e* is often elided (cf. Smith 1967) in nonhiatal configurations as in (116).

(116) *'e'-elision in nonhiatal context*

ezà	nana	→	zà nana
person	this		'this person'

epã	nana	→	nã nana
thing	this		‘this thing’
eʃigi	nana	→	ʃigi nana
dog	this		‘this dog’
enangi	nana	→	nangi nana
goat	this		‘this goat’

Furthermore, that  $V_2$  elision only affects the nominal prefix is borne out by the fact that in words beginning with /a/, the only other vowel that begins words in the language, the /a/ is not elided in hiatal configurations since it is not an affix.

(117) *Retention of nonprefixal  $V_2$  in hiatus*

egi	árata	→	e.gi.a.ra.ta	(*egi.ra.ta)
child	fifty		‘fifty children’	
ète	árata	→	è.ti.a.ra.ta.	(*ète.ra.ta)
gum	fifty		‘fifty gums’	
etsu	árata	→	e.tsu.a.ra.ta	(*e.tsu.rata)
king	fifty		‘fifty kings’	
ègo	árata	→	è.go.a.rata	(*è.go.ra.ta)
worm	fifty		‘fifty worms’	

Besides being retained in hiatal configurations /a/ is not elided in nonhiatal configuration the same way that /e/ is in some common nouns (cf. 116). Thus *árata o* (it’s fifty) is *áratoo*, and never *\*ratoo*.

Finally, when the *e* in an *e*-CV form cannot be plausibly analyzed as a nominal prefix, it is not elided. Smith (1967) observes that words of the structure *e*-CV are all

nouns except /ebà/ 'yes'. In the meaningful context in which this occurs in hiatus given in (118), *e* is not elided. Instead  $V_1$  assimilates its features as in the relevant context featured earlier.

(118) *Retention of nonprefixal 'e' as  $V_2$  in hiatus*

u	gà	ebà	→	u gèẽ bà	(*u gǎbà)
3rd Pers. Sing.	say	yes		'he said yes'	

That the *e* in *ebà* is not a nominal prefix is borne out by the fact the word can be truncated. When this happens it is the CV part (*bà*) that is cut. Consequently (118) is more commonly rendered as *u gèẽ* without any loss of content or meaning. This is indication that the 'yes' meaning is encoded by 'e'.

Elision can now be accounted for by ranking the special constraint MAX-IO-AFFIX in the hierarchy motivated for glide formation and assimilation. It is crucial for the account to demonstrate why glide formation and assimilation fail in cases where  $V_2$  is a prefix. Ranking the constraints violated by glide formation (IDENT-IO(vocalic)) and assimilation (ANCHOR-FEATURE-IO) above MAX-IO-AFFIX should suffice to derive elision of the nominal prefix. But in an input where  $V_1$  is identical to the nominal prefix such an interaction does not suffice to guarantee elision, as the identical vowels can be tautosyllabified. The resulting sequence violates neither IDENT-IO(vocalic) nor ANCHOR-FEATURE-IO. It however violates the general constraint against complex nuclei. I indicated earlier that the general constraint is dominated by the special version featured in the analysis of glide formation and assimilation. The general constraint is needed for the



analysis of elision. The constraint interaction needed to account for elision as hiatus resolution strategy when  $V_2$  is a prefix is as in (119).<sup>5</sup>



(119) *Ranking for elision as hiatus resolution strategy*

NOHIATUS, MAX-IO-ROOT, ANCHOR-FEATURE-IO » \*COMPLEX-NUC[ $V_iV_j$ ] »

IDENT-IO(vocalic) » COMPLEX-NUC » MAX-IO-AFFIX

The ranking (119) is illustrated in the tableau in (120) with two different types of input.

(120) *Tableau for elision as optimal analysis of hiatus resolution*

Input: li + ezà	NO HIATUS	MAX- IO-RT	ANC- FEAT-IO	*COMP- NUC[ $V_iV_j$ ]	IDENT- IO(voc)	*COM- NUC	MAX- IO-AF
a. li.e.zà	*!						
b.lje.zà					*!		
c.lee.zà			*!			*	
d.le.zà		*!					
e.  li.zà							*
Input: de + egi							
a.de.e.gi	*!						
b.dee.gi						*!	
c.  de.gi							*

In an input consisting of  $V_1$  that is not identical to the prefixal vowel, heterosyllabic parsing results in a fatal violation of NOHIATUS. The glide formation candidate (b) incurs a fatal violation of IDENT-IO(vocalic). The assimilation candidate (c) avoids a violation of IDENT-IO(vocalic), but has the features of the  $V_2$  realized on  $V_1$ . This results in a fatal violation of ANCHOR-FEATURE-IO. Candidate (d) avoids the violations of the glide and assimilation candidates by deleting the root vowel. It thus incurs a fatal violation of MAX-IO-ROOT. It differs from candidate (c) by satisfying \*COMPLEX-NUC. Candidates (a, b, c, d) all satisfy MAX-IO-AFFIX. The optimal candidate (e) avoids a violation of \*COMPLEX-NUC in the same way that candidate (d) does, but does so by deleting the

<sup>5</sup> Implicit in this ranking is the assumption that  $V_1$  and  $V_2$  in the glide formation and assimilation data are

prefixal vowel. This results in a violation of MAX-IO-AFFIX. The violation is however not fatal as the constraint is ranked lowest in the hierarchy. The ranking between \*COMPLEX-NUC and MAX-IO-AFFIX is not obvious from the input considered thus far. In the input with  $V_1$  identical to the prefixal vowel, retaining the prefixal vowel by tautosyllabifying it with  $V_1$  results in a complex nucleus. This is why candidate (b) in the second input incurs a fatal violation of \*COMPLEX-NUC. Effectively, elision specially affects the nominal prefix *e* as  $V_2$  in hiatus, and neither glide formation nor assimilation is an optimal strategy in such configurations.

Glide formation and assimilation on one hand, and elision on the other differ in one significant respect. While glide formation and assimilation result from tautosyllabification, elision does not. The implication is that elision, unlike glide formation and assimilation, does not involve tautosyllabic parsing of input vowels. Elision has however been regarded by some as involving the fusion of syllables (cf. Laniran 1992 on Yoruba vowel deletion) to the effect that the surviving syllable contains both vowels in hiatus. This view of elision in the OT framework will assume that elision like glide formation and assimilation does not involve MAX-IO violations. This can be achieved by indexing the surviving vowel with the number of input vowels. But in the overall approach to hiatus resolution developed here and to be consistent with OT accounts of hiatus resolution (cf. Casali 1996, 1997) elision does incur MAX-IO violations. To the extent that there is no overt reflex of the deleted vowel in the surviving vowel as distinguished from glide formation and assimilation in which the emergent

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root segments,  $V_2$  as syntactically bound forms notwithstanding.

syllable contains both vowels in hiatus, albeit with identity changes, elision may not be regarded as syllable fusion.

### 6.1 *Interim summary I*

The foregoing analyses of glide formation, assimilation, and elision as hiatus resolution strategies in Nupe suggest that the patterns can follow from a single constraint hierarchy without resorting to reranking and the attendant paradoxes. This is made possible by integrating universal tendencies with language particular idiosyncrasies, and motivating and deploying special constraints accordingly. The constraint hierarchy that accounts for three hiatus resolution strategies in Nupe is as in (121). Abstracting away from the high-ranking constraints, the subhierarchy for each strategy is given in (122).

#### (121) *Final ranking for hiatus resolution patterns in Nupe*

NOHIATUS, MAX-IO-ROOT, IDENT-MI-IO, \*LOW-GLIDE » ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(vocalic), IDENT-IO(low) » COMPLEX-NUC » MAX-IO-AFFIX

#### (122) *Hiatus resolution strategy subhierarchies*

##### a. *Glide formation subhierarchy*

ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(vocalic)

##### b. *Assimilation subhierarchy*

\*LOW-GLIDE » ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(low)

##### c. *Elision subhierarchy*

MAX-IO-ROOT » ANCHOR-FEATURE-IO » \*COMPLEX-NUC[V<sub>i</sub>V<sub>j</sub>] » IDENT-IO(vocalic) » COMPLEX-NUC » MAX-IO-AFFIX

In the next section I consider the behavior of [e] with a view to determining if it differs in any significant way from the other vowels in the language.

## 6.2 *Something about [e]?*

The behavior of [e] in hiatal configurations and its occurrence as the nominal prefix raises the question of its structural property. This is especially with respect to its underlying representation. When segments behave differently from others in the inventory of languages the tendency is to regard such segments as having structural properties different from those of other segments. While some segments are fully specified with respect to certain features others are underspecified for the same features. The underspecified features are acquired at later stages in the derivation. This forms the core of the theory of underspecification. This has been used to account for the asymmetric behavior of the vowel [i] in Yoruba (Pulleyblank 1988a). That underspecification may not follow from universal markedness considerations, and that languages may differ with respect to underspecified segments motivates the analysis of [e] as the underspecified vowel in Gengbe (Abaglo & Archangeli 1989). I explore the arguments in these two works to determine whether the vowel [e] can be regarded as underspecified in Nupe.

One of the determinants of a segment's underlying specification is its behavior with respect to phonological rules, either as a trigger or a target. It is either the only segment that undergoes certain rules or the only one that does not. It might also be the only segment that triggers or fails to trigger some rules. On this view, the vowel [e] has no exceptional behavior in Nupe. In the discussion of the distribution of stridents in Nupe (chapter 2, section 3), it was shown that palatal stridents are found before [coronal] and